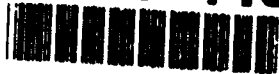


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MANAGING PROCESS IMPROVEMENT

A GUIDEBOOK FOR IMPLEMENTING CHANGE

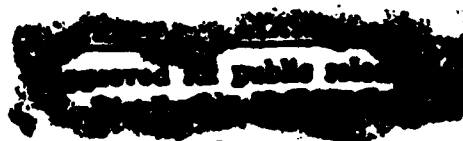
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This guidebook provides practical guidance on how to successfully initiate and sustain a process improvement program. Written for advocates and implementors of process improvement, the guidebook is distilled from a broad base of experience and research in systematic process management. This guidebook also offers general guidelines for optimizing an organization's process improvement process.

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PREFACE

The technology described in this guidebook is part of a broad approach to software productivity improvement. This preface provides an overview of that approach and identifies the series of guidebooks that support it. These guidebooks were developed by the Software Productivity Consortium under contract to the Virginia Center of Excellence for Software Reuse and Technology Transfer (VCOE). For a complete listing of VCOE guidebooks and products, call the Software Productivity Consortium's Technology Transfer Clearinghouse at (703) 742-7211.

Each technology has been packaged so it can be used without reference to the other technologies. However, it is also possible to combine these technologies into an integrated approach for product development. Figure P-1 shows how the guidebooks for these technologies relate to the practices of software development organizations.

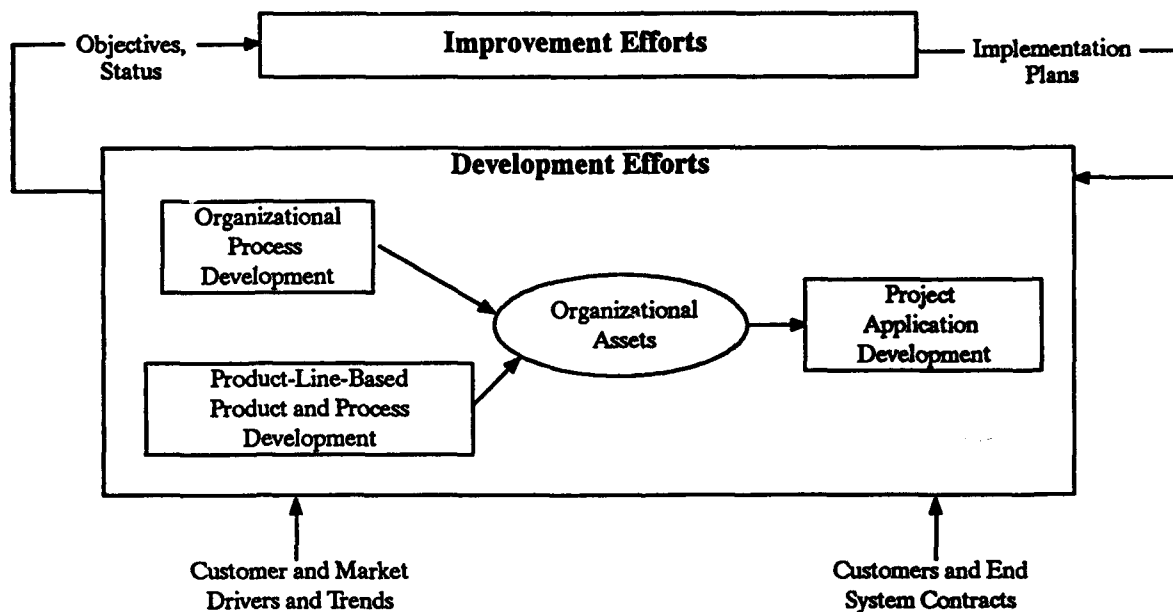


Figure P-1. Structure for Integrated Application of Consortium Technologies

These practices are composed of:

- **Improvement Efforts (IE).** Application of technology to improve software development efforts. These efforts require managed approaches to assessment of objectives and current capabilities, planning for the improvement, implementation of the plan, and measurement of success.
- **Development Efforts.** Development of products that meet the needs of customers and markets or products that make the organization more competitive in meeting expected future needs.

- **Organizational Process Development (OPD).** Development of standardized organizational process assets (e.g., process and method descriptions, process enactment tools) tailored for a particular organization.
- **Product-Line-Based Product and Process Development (PLD).** Development of integrated product and process assets (e.g., core products and processes for adapting them for particular customer needs) appropriate for a particular product line.
- **Project Application Development (PAD).** The tailoring and application of organizational assets for a particular product development effort.

Table P-1 describes how existing products can be integrated to address your organizational practice.

Table P-1. Consortium Guidebooks and Related Practices

Guidebook	Part Number	Relationship to Software Practice
<i>Consortium Requirements Engineering Guidebook</i>	SPC-92060-CMC	Used for defining and analyzing requirements in PAD. Adaptable for use in PLD.
<i>Managing Process Improvement: A Guidebook for Implementing Change</i>	SPC-93105-CMC	Supports IE by providing a process and supporting guidance for initiating and maintaining an organizational process improvement program.
<i>Process Definition and Modeling Guidebook</i>	SPC-92041-CMC	Provides methods for defining and documenting processes so they can be analyzed, modified, and enacted. Supports IE and OPD.
<i>Process Engineering With the Evolutionary Spiral Process Model</i>	SPC-93098-CMC	Used to iteratively plan, manage, and control PAD and PLD. Used to construct organization-specific processes in PLD and tailor them in PAD.
<i>Reuse Adoption Guidebook</i>	SPC-92051-CMC	Supports IE by providing specific process improvement activities for incorporating reuse practices.
<i>Reuse-Driven Software Processes Guidebook</i>	SPC-92019-CMC	Provides development approaches for PLD (domain engineering) and PAD (application engineering) of reusable software assets.
<i>Software Measurement Guidebook</i>	SPC-91060-CMC	Supports IE by providing methods for quantitative assessment of project status.
<i>Using New Technologies: A Technology Transfer Guidebook</i>	SPC-92046-CMC	Supports IE by providing a process that addresses how to get an organization to use new technologies.

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1. INTRODUCTION TO PROCESS IMPROVEMENT

A competitive world has two possibilities for you. You can lose. Or, if you want to win, you can change.

Lester C. Thurow, Dean, MIT Sloan School of Management

Section Objectives

1. Explain why you should use this guidebook

2. Describe how to use this guidebook

This guidebook guides you through initiating and maintaining a process improvement program in your organization. Specifically, this guidebook helps you to:

- Understand and implement the steps to improve your software process
- Gain broad support for and manage the human challenges of major change, such as process improvement
- Successfully initiate and sustain a process improvement program

The primary audience for this guidebook includes:

- Persons advocating process improvement
- Persons implementing process improvement

The secondary audiences includes persons who control resources for process improvement and persons affected by process improvement. Whether you are at the beginning or already have a process improvement effort underway (or even if you are trying to reinvigorate a stalled one), this guidebook can help you.

A software process is a set of activities that people perform to develop and maintain software and associated products (e.g., project plans, design documents, code, test cases, user manuals, etc.). The people, process, and technologies used to implement the process are interdependent and affect successful cost, schedule, and quality performance.

The remainder of this section provides reasons why you should initiate a process improvement program in your organization and explains how to use this guidebook.

1.1 SOFTWARE PROCESS IMPROVEMENT: WHY IT IS ESSENTIAL

Recent estimates by IDC Software Research (Brandt, Schwartz, and Gross 1991) indicate that the U.S. currently controls about 57% of the global

software market, the total value of which is estimated to be as high as \$58 billion, making it one of our nation's most valued—and threatened—areas of technological superiority.

The U.S. software industry is being challenged from many directions: European firms are increasingly refusing to buy or receive bids from suppliers whose quality systems do not comply with International Standards Organization (ISO) 9000 standards; India's software market grew 47% to \$112 million in 1992, while exports of software packages rose to \$144 million (Bhargava 1993); software development costs in the United States are five to six times more than those of Singapore (Yourdon 1992). As time passes, the existence of a systematic software process improvement program is moving from an option to a necessity—part of the cost of doing business or, more positively, essential to your competitiveness.

The message is clear: The U.S. software industry must increase its competitiveness to maintain and expand its dominance in the worldwide arena.

1.2 WHY THIS GUIDEBOOK CAN HELP YOU

This section discusses the experiences and lessons learned on which this guidebook is based. Expected benefits from improving your process are enumerated.

.....

THIS GUIDEBOOK INCORPORATES THE LESSONS OF EXPERIENCE

This guidebook incorporates material that is the result of many years of industrial experience, both in general and for software in particular. The principles behind the software quality movement are based on a similar movement in the manufacturing industry that occurred over several decades.

In 1920, after the introduction of the assembly line, product inspection was the way to control quality, sometimes referred to as "inspecting in quality." Around 1960, Japan began a major effort to penetrate the global electronics market and adopted statistical process control methods to improve quality in manufacturing. Japan's success has driven most manufacturers to adopt similar techniques. In the 1980s, attention shifted to improving the underlying process and product designs to achieve quality control and improvement, sometimes referred to as "building in quality." This shift of emphasis from a product-centered to a process-centered approach to quality has not been easy or quick.

Process management provides a systematic approach to planning, managing, and improving quality. Shewart introduced a continuous process improvement cycle, called Plan-Do-Check-Act (Deming 1982). Juran (1981) defined a four-step approach to quality improvement. Deming (1982) proposed a 14-point, organization-wide approach to quality management. Crosby (1979) developed a quality management maturity framework to identify where an organization stands from a quality viewpoint. Incorporating these ideas and approaches, the Software Engineering Institute (SEI), funded by the Department of Defense, developed a conceptual framework, the Capability Maturity Model for Software (CMM), that provides an evolutionary path for improving the way you manage software activities.

The key message from these and other leaders in the quality movement is that long-term improvement can be attained only from systematic analysis and actions, not simply by exhortations or management by objectives (Paulk et al. 1993, App. B).

The Software Productivity Consortium has been involved in helping many organizations in industry improve their software process and is an authorized vendor for the SEI Software Process Assessment. This guidebook outlines a systematic process for you to follow in order to initiate and sustain a process improvement program in your organization. This guidebook is based on research, experiences, and lessons learned from improving processes. Take advantage of its hard-won lessons on how to improve your process using successful approaches and with knowledge of where the pitfalls are, so that you can duck the same arrows that pioneers have already suffered.

.....

POTENTIAL BENEFITS ARE NUMEROUS

When improving and defining your process, your organization can expect to experience some of the following benefits:

- ***Decreased Reliance on Testing to Ensure Quality.*** Reviews become an integral part of the process—throughout the life cycle.
- ***Improved Teamwork.*** Communication among the process users, managers, process developers, and customers is more effective.
- ***Reduced Rework.*** You identify and eliminate problems early in the process rather than later.
- ***Efficient Project Staff Start-Up Time.*** There is a documented process on which to train them.
- ***Reduced Development Costs.*** You develop less and reuse more.

- **Improved Predictability of Budgets and Schedules.** You stabilize development activities and, therefore, know what to measure, when to measure it, and how to use the information.
- **Improved Tool Usage.** The right tools can be selected the first time to fit the process you know you will use.
- **Faster Project Start-Up.** The project can build on and tailor a documented history of what it has done in the past.

1.3 HOW TO USE THIS GUIDEBOOK

This section tells you the content of each section of this guidebook and whether it is relevant to you. Related guidebooks and their purposes are described.

.....

GUIDEBOOK CONTENTS

This guidebook is organized as follows:

- Section 1, Introduction to Process Improvement, provides a compelling argument for initiating a process improvement program.
- Section 2, Why Process Improvement is Difficult, identifies the key challenges you will face and explains how to apply change management principles to address them.
- Section 3, How Do You Use the Process Improvement Process?, explains the fundamentals of using this process and introduces the format of Sections 4 through 8.
- Section 4, Establish a Baseline: Understand Context, helps you to understand your organizational and technical environment, and to define objectives and alternatives for how to proceed.
- Section 5, Look Before You Leap: Analyze Risks and Select Strategy, helps you to analyze and resolve the risks associated with the process improvement program, and to select the most appropriate strategy for your organization.
- Section 6, Chart a Course: Plan Improvements, helps you to plan the next step of your process improvement implementation.
- Section 7, Just Do It: Implement Improvements, helps you to implement and manage process improvements, as defined by your action plan.

- Section 8, Steer for Success: Review and Update, helps you to interpret the results of the program to date and provides guidance on how to proceed, based on these results.
 - Section 9, Improving Your Process Improvement Process, provides guidance for becoming more proactive in supporting your process improvement program.
 - Appendix A, Checklists for Applying the Process Improvement Process, provides three checklists for guiding the implementation of process improvement tasks.
 - Appendix B, Software Process Assessment Methods, provides an overview of three popular software process assessment methods.
 - Appendix C, Assessment Findings Presentation Outline, provides an outline for an assessment findings presentation.
 - Appendix D, Findings and Recommendations Report Template, provides a template for a findings and recommendations report.
 - Appendix E, Assessment Recommendations Presentation Outline, provides an outline for a recommendations presentation.
 - Appendix F, Risk Management Plan Template, provides a template for a risk management plan.
 - Appendix G, Action Plan Template, provides a template for an action plan.
 - Appendix H, Measuring Process Improvement, provides an overview of process and product measurements that are useful for measuring improvements.
-

WHICH SECTIONS ARE FOR YOU

To help you decide which sections you should read, see Table 1-1, which identifies the audience types and the sections of this guidebook that each should read. Keep in mind that at any one time, you may fit the description of more than one audience type; for example, you may control resources as well as be affected by process improvement efforts.

Table 1-1. Guidebook Audience

Audience Type	Section				
	1	2	3	4-8	9
Person implementing improvements	✓	✓	✓	✓	✓
Person controlling resources	✓	✓			✓
Person advocating process improvement	✓	✓	✓	✓	✓
Person affected by process improvements	✓	✓			

RELATIONSHIP OF PROCESS IMPROVEMENT TO TECHNOLOGY TRANSFER

The related processes of process improvement and technology transfer have the same high-level goal: to improve your organization's practices by changing the way the staff works. What differs is the focus and scope—process improvement is concerned with the improvement of an entire process, whereas technology transfer (sometimes referred to as technology transition) is concerned with the improvement of a certain technical area through the use of a new technology.

To implement and support these related processes, this guidebook and the guidebook *Using New Technologies: A Technology Transfer Guidebook* (Software Productivity Consortium 1993e) are integrated. Specifically, the integration of the process improvement process and the technology transfer process follows these guidelines:

- **Similar Processes.** Since the high-level goals of the process improvement process and technology transfer are similar, the processes, including the activities and ordering of the activities, is similar.
- **Similar Guidance.** Each provides guidance that applies to both processes as well as guidance that is specific to its own process; this latter guidance is what makes each guidebook unique to the problem that you are solving.
- **Similar Appearance.** The two guidebooks intentionally have been formatted similarly, so that, if necessary, you can easily refer to one guidebook from the other.

This guidebook refers you to *Using New Technologies* at the appropriate points during the process improvement process.

.....

OTHER RELATED GUIDEBOOKS

Several other guidebooks provided by the Consortium may also be of interest to you. Persons wishing more information on defining and modeling their process can refer to *Process Definition and Modeling Guidebook* (Software Productivity Consortium 1992a). For more on process engineering, refer to *Process Engineering With the Evolutionary Spiral Process Model* (Software Productivity Consortium 1993b). For improving software reuse, refer to *Reuse Adoption Guidebook* (Software Productivity Consortium 1993c).

Additional materials include the *Software Measurement Guidebook* (Software Productivity Consortium 1992b), *Reuse-Driven Software Process Guidebook* (Software Productivity Consortium 1993d), and *Consortium Requirements Engineering Method Guidebook* (Software Productivity Consortium 1993a), all from the Virginia Center of Excellence in Software Reuse and Technology Transfer.

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2. WHY PROCESS IMPROVEMENT IS DIFFICULT

We have met the enemy, and he is us.

Walt Kelly, Creator of Pogo (comic strip character)

Section Objectives

1. Discuss the complexity of your organization

2. Explain change management principles and why they are critical to your change efforts

You are reading this guidebook because your organization needs to:

- Decrease the time it takes to develop software
- Decrease the cost of producing software
- Increase the quality of your software products
- Increase the predictability of your performance
- Increase your capacity to produce wealth (i.e., capability and market)

To achieve these objectives, you must first understand why achieving substantial improvement is not a simple, straightforward problem to solve. This section discusses the many facets of your organization and the fundamental concepts underlying organizational change.

2.1 YOUR ORGANIZATION IS A COMPLEX SYSTEM

Consider your organization as a set of interrelated subsystems operating in an organizational environment, as depicted in Figure 2-2 (Morgan 1986). For your organization to be efficient, you need to analyze and improve each of these subsystems:

- *Strategic.* Does your organization have a business strategy, or does it simply react to whatever changes come along?
- *Technological.* Are the processes that transform inputs into outputs standardized and institutionalized? Do the processes rigidify operations, or are they flexible? What types of technologies are being used?
- *Human/Cultural.* What are the core values, behaviors, and unwritten rules that shape your organization's culture? What orientations do people bring to work? Are they searching for challenge and involvement, or simply working for money?

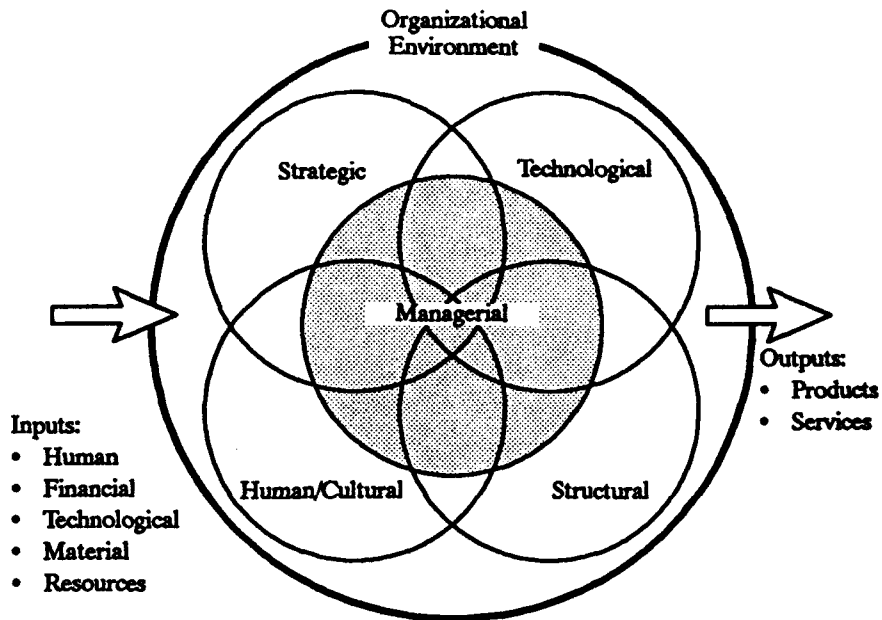


Figure 2-2. Organizational Subsystems

- **Structural.** Is your organization bureaucratic, hierarchical, or matrix in structure? Are Integrated Product Teams (IPTs) used?
- **Managerial.** Does the dominant managerial philosophy stress accountability and control (authoritarian), or encourage initiative and enterprise (democratic)? Does the organization stress innovation and risk taking?

It is interesting to note that all but the managerial and human/cultural subsystems can be duplicated by your competition. Most of this guidebook focuses on improving the technological and managerial subsystems of your organization. Since these five subsystems are interrelated, this guidebook also addresses the other subsystems, thus presenting a more integrated approach to process improvement.

2.2 HUMAN ASPECTS OF CHANGE ARE THE MOST CHALLENGING

The most important asset to your organization is its people. The people who are involved with and affected by change are considered the **stakeholders** of the change. History has demonstrated that major changes, such as process improvement, are likely to fail when the stakeholders are unprepared for its implementation.

This guidebook addresses both the human as well as the technical challenges in implementing process improvement so that you can increase the likelihood of successful implementation. To provide a solid foundation for you to best understand and apply this guidance, this section covers the following topics:

- Implementation climate within your organization
 - Readiness of your organization for change
 - Process of change
 - Potential responses to change
-

IMPLEMENTATION CLIMATE

The atmosphere of an organization can greatly impact the success of process improvements. One way to get a reading of the atmosphere, or climate, is by looking at the organization's history of change and the stress of individuals within the organization (Implementation Management Associates 1992).

A history of process improvement efforts that is perceived as unsuccessful produces an unfavorable climate for future changes. Employees question what will be different this time around. Managers question the motives of their managers. We continually hear statements such as, "We've been down this road so many times that we've worn out the pavement"; "same song, different verse"; "the more things change, the more they stay the same"; and so on.

Stress also affects the organization's ability to implement process improvements. Organizations that add one more activity to the already overloaded schedules of their staff, are likely to suffer the consequences of dysfunctional behavior. Each activity, taken in isolation, is doable, but, when taken collectively, may possibly exceed your staff's stress limits. Process improvements do not occur in isolation, but it is very difficult to achieve success when there are four number-one priorities causing excessive stress on the organization and its individuals.

This guidebook shows you how to integrate process improvement with other thrusts, such as Total Quality Management (TQM), and to minimize the potential of overloading your organization.

.....

ORGANIZATIONAL READINESS

An organization is more apt to be successful when change is compatible with the culture of the organization. When the change is incompatible with the culture, culture always prevails. The level of cultural fit with the change greatly affects stakeholder readiness and acceptance of the change, and, thus, the probability of success.

Change has the greatest chance of success when your organization is unified in its purpose and direction, and has a culture that supports change. Figure 2-3 depicts several scenarios of organizational readiness, of which only one is really conducive to change (Perkins 1991).

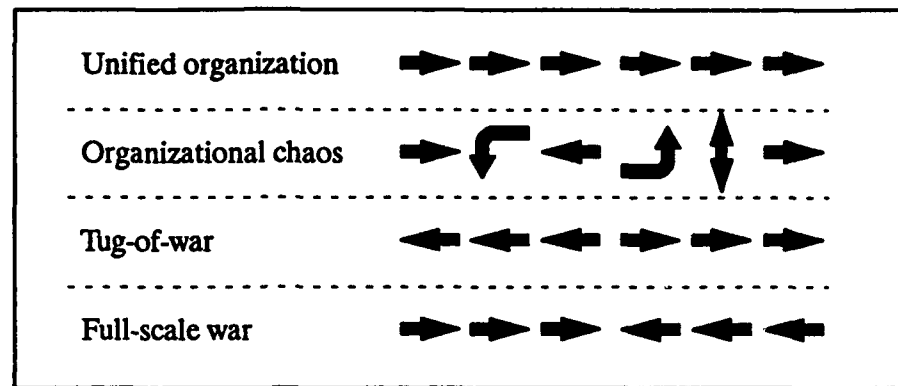


Figure 2-3. Scenarios of Organizational Readiness

CHANGE IS A MULTI-STAGE PROCESS

The one-stage model of change, sometimes called the “hammer” approach, usually occurs by edict or mandate, to the effect of, “Beginning today, you will do things a new way.” Compliance, or the appearance of compliance, is the typical result of the hammer approach.

Experience has shown that successful change typically occurs in three stages, not one. The three-stage model, shown in Figure 2-4, illustrates the

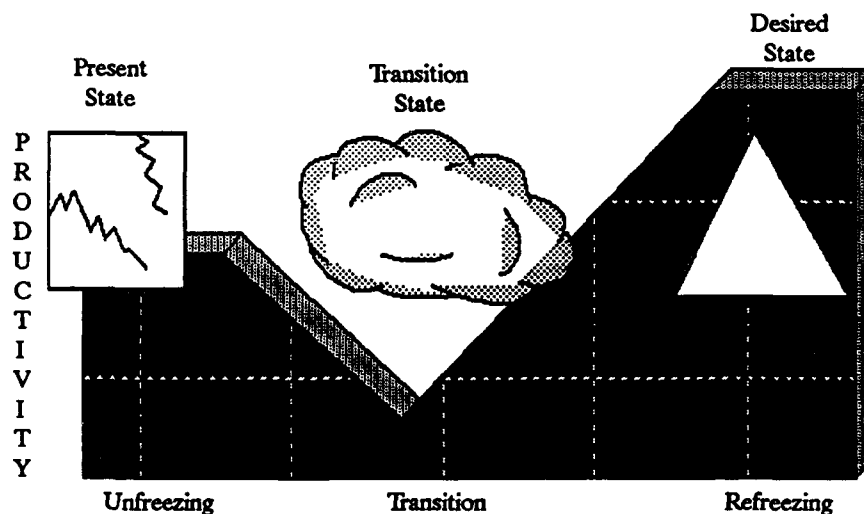


Figure 2-4. Transition Model of Change

need to communicate the **why** and **how**, not solely the desired outcome. The terms used to describe these stages can be found in Conner (1993), Implementation Management Associates (1992), and Software Engineering

Institute (1992). Similar concepts can be found in Kirkpatrick (1985) and Egan (1988). The stages are as follows:

- **Unfreezing.** In this stage, the need for change is stressed. For successful unfreezing, the cost of not changing (i.e., keeping the status quo) must exceed the cost of changing; in other words, an organization must be in pain. This stage motivates the stakeholders, based on a vision of the new way, to consider changing the present state.
- **Transition.** This stage is characterized by ambiguity, fear of the unknown, instability, and resistance, and involves planning and implementing the proposed changes. Clear transition steps, with substantial organizational involvement, are required to counter the uncertainty inherent in transition. If this stage is not managed properly, people revert to "business as usual."
- **Refreezing.** This stage involves the ongoing implementation of the proposed changes and the institutionalization of those changes. The productivity and morale of the organization rebounds due to the visibility and realization of the benefits of improvement, thus achieving the desired state.

This model of change implementation provides a framework to understand, manage, and accelerate the change process. The guidance in this guidebook helps you to use this model to maximize commitment, minimize resistance, and increase the probability of implementation success. Also, this guidebook helps you to phase in changes, so that the entire organization never drops below the sustaining level of productivity in the transition stage.

.....

HUMAN RESPONSES TO CHANGE ARE COMPLEX

Resistance is a natural response to change that causes major disruptions to or inconsistencies in the status quo. The more dramatic the change or its perceived consequences, the greater the resistance. You can increase your effectiveness of implementing change by understanding and respecting this response.

People express their resistance differently. Covert resistance, the harder type to manage, occurs when people disagree with the change and its consequences, but do not voice their concerns. Instead, they may choose to undermine or sabotage the change. Overt resistance is much easier to manage; people articulate their concerns, and you can directly address the issues.

People respond to change differently. What one person feels is a positive change may be seen by another as a negative. Some people resist change even if the change is perceived to be positive.

The typical reaction pattern to a perceived positive change is depicted in Figure 2-5. The terms used to describe these stages are found in O.D. Resources (1989), and are as follows:

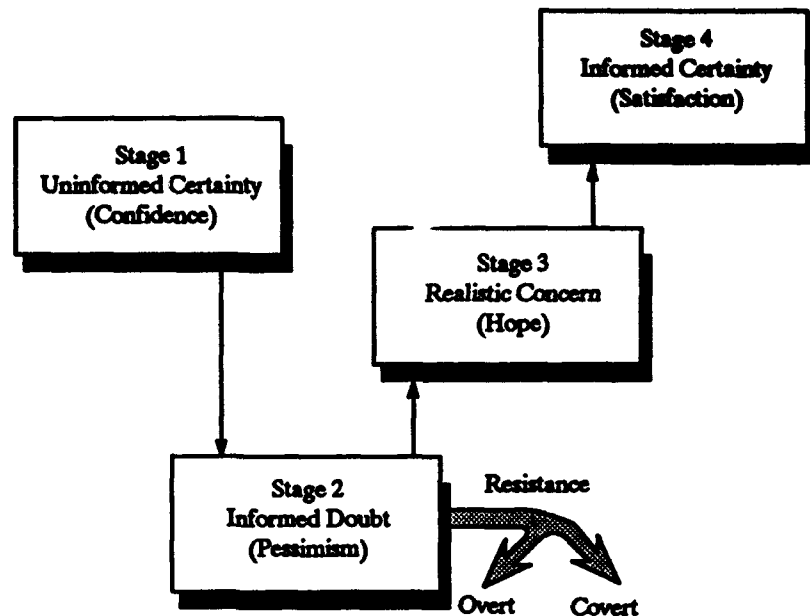


Figure 2-5. Response to a Perceived Positive Change

- **Stage 1, Uninformed Certainty.** In this stage, a person is confident that the change is entirely for the better and has high expectations for the results.
- **Stage 2, Informed Doubt.** In this stage, a person begins to realize that expectations were set too high. Resistance is most likely to surface during this stage and can be either covert or overt.
- **Stage 3, Realistic Concern.** In this stage, a person begins to reconcile expectations with reality and to think positively about the change.
- **Stage 4, Informed Certainty.** In this last stage, a person is once again confident of success, but only because of a better understanding of what will and will not change.

The typical reaction pattern to a perceived negative change, as depicted in Figure 2-6, is more complex and, at times, subtle. It typically follows this pattern (Kubler-Ross 1981):

- **Stunned Paralysis.** The initial reaction to a perceived negative change is one of stunned paralysis. The change is so foreign to an individual's frame of reference that it causes immobilization.
- **Denial.** In this stage, the individual denies the need to change.

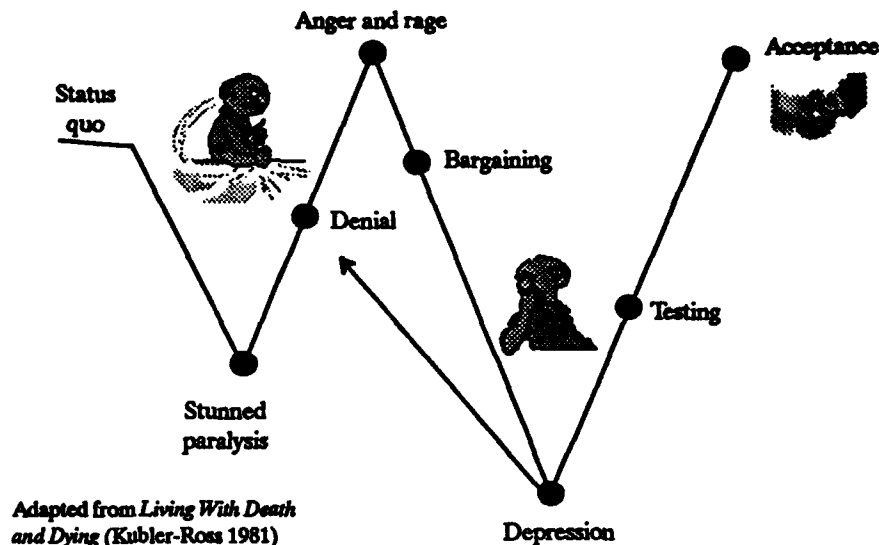


Figure 2-6. Response to a Perceived Negative Change

- **Anger and Rage.** Emotions of hurt and frustration tend to surface during this stage.
- **Bargaining.** This stage marks the beginning of acceptance and is characterized by the individual negotiating around the change by requesting exemptions or extensions.
- **Depression.** When bargaining does not yield the desired results, the individual begins to understand the full extent of the change and its consequences.
- **Testing.** The individual begins to show acceptance of the change by testing its boundaries and limitations.
- **Acceptance.** The individual now accepts the change and its implications. Acceptance of change does not imply that the individual likes the change.

Some behaviors, such as denial and depression, may be difficult to observe and manage. The depression phase is a pivotal point when an individual is ready to think about the desired state. Without proper "care," the individual may slip back to the denial stage instead of moving forward.

This guidebook provides insights on how to manage both types of responses to change, so that you can focus on the desired state and achieve your objectives sooner.

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3. HOW DO YOU USE THE PROCESS IMPROVEMENT PROCESS?

Give a man a fish and you feed him for a day; teach him how to fish and you feed him for a lifetime.

Well-known proverb

Section Objectives

1. Introduce the process improvement process

2. Explain how to use this process

This section introduces the process for improving your software processes, provides suggestions and advice on using the process successfully, and describes how to use this guidebook. Read this section before you proceed to the next section.

3.1 A PROCESS IMPROVEMENT PROCESS

When planning process improvement, it is natural to envision implementing a series of activities performed one after the other. The planner is tempted to lay out a scheme of such activities, joined by arrows, with planned start and finish dates for each. Unfortunately, successful process improvement never follows such a predetermined, static plan. In reality, we are unable to predict, much less mitigate, changing or incomplete factors (both internal and external forces) that influence each step of the improvement process. Experience has shown that straight-line (often called "waterfall") models are not effective in managing such dynamic interactions.

Though process improvement activities and their dates cannot be accurately predicted in detail far in advance, a well-structured and executable plan can be developed by considering a set of core activities you can plan and execute in an iterative manner. Figure 3-1 presents these steps:

- Step 1: Understand Context
- Step 2: Analyze Risks and Select Strategy
- Step 3: Plan Improvements
- Step 4: Implement Improvements
- Step 5: Review and Update

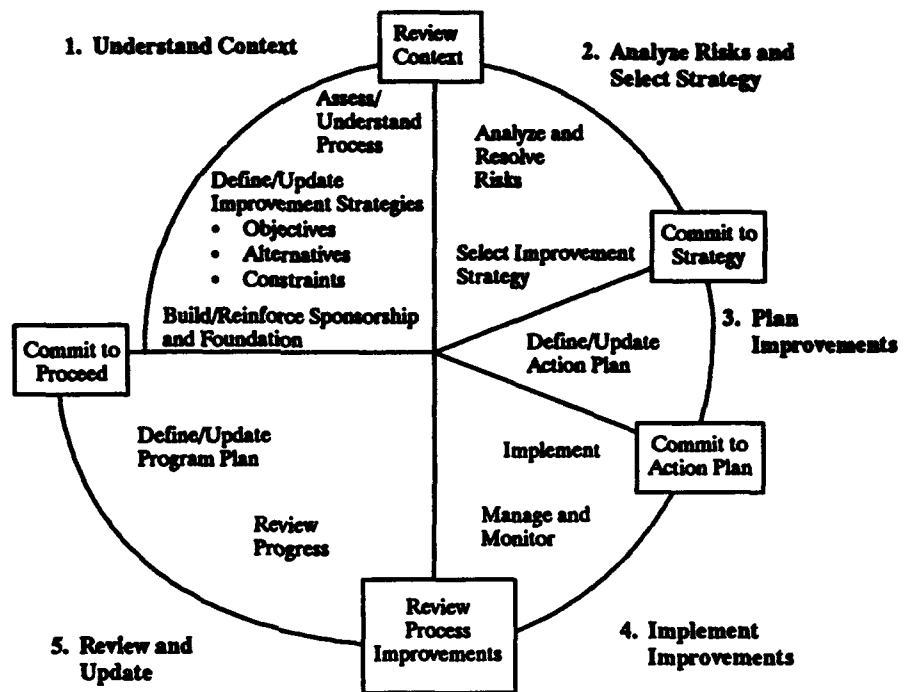


Figure 3-1. Process Improvement Process

These steps are illustrated as a cycle to portray how you move through them (clockwise movement around the center), continually progressing (moving away from the center) toward your goals. In each cycle, you will develop a good understanding of your current situation, identify alternative ways to improve, evaluate risks, successfully plan and implement changes, accurately assess progress, and plan the next increment. The process recognizes that you may need to iterate cycles to achieve your objective.

The remainder of this guidebook helps you manage your process improvement process using this successful approach based on the Evolutionary Spiral Process described in *Process Engineering With the Evolutionary Spiral Process Model* (Software Productivity Consortium 1993b).

3.2 A MODEL OF PROCESS IMPROVEMENT

You perform process improvement by repeating the five steps, which comprise one cycle, using the knowledge gained and lessons learned from previous cycles. Multiple cycles together form a spiral to accomplish a specific objective, such as to institutionalize project management principles.

Figure 3-2 a process improvement spiral (starting from the inside and growing out) that:

- Highlights the main activities of the process improvement process

- Is based on the scenario that one or more staff members (i.e., change agents and/or champions) decide to pursue process improvement, without management initiation

If you do not have management authorization to do these activities, but still want to champion process improvement, perform the activities in the first cycle on your own time.

- Shows a spiral being spun off to address the implementation of a specific process improvement

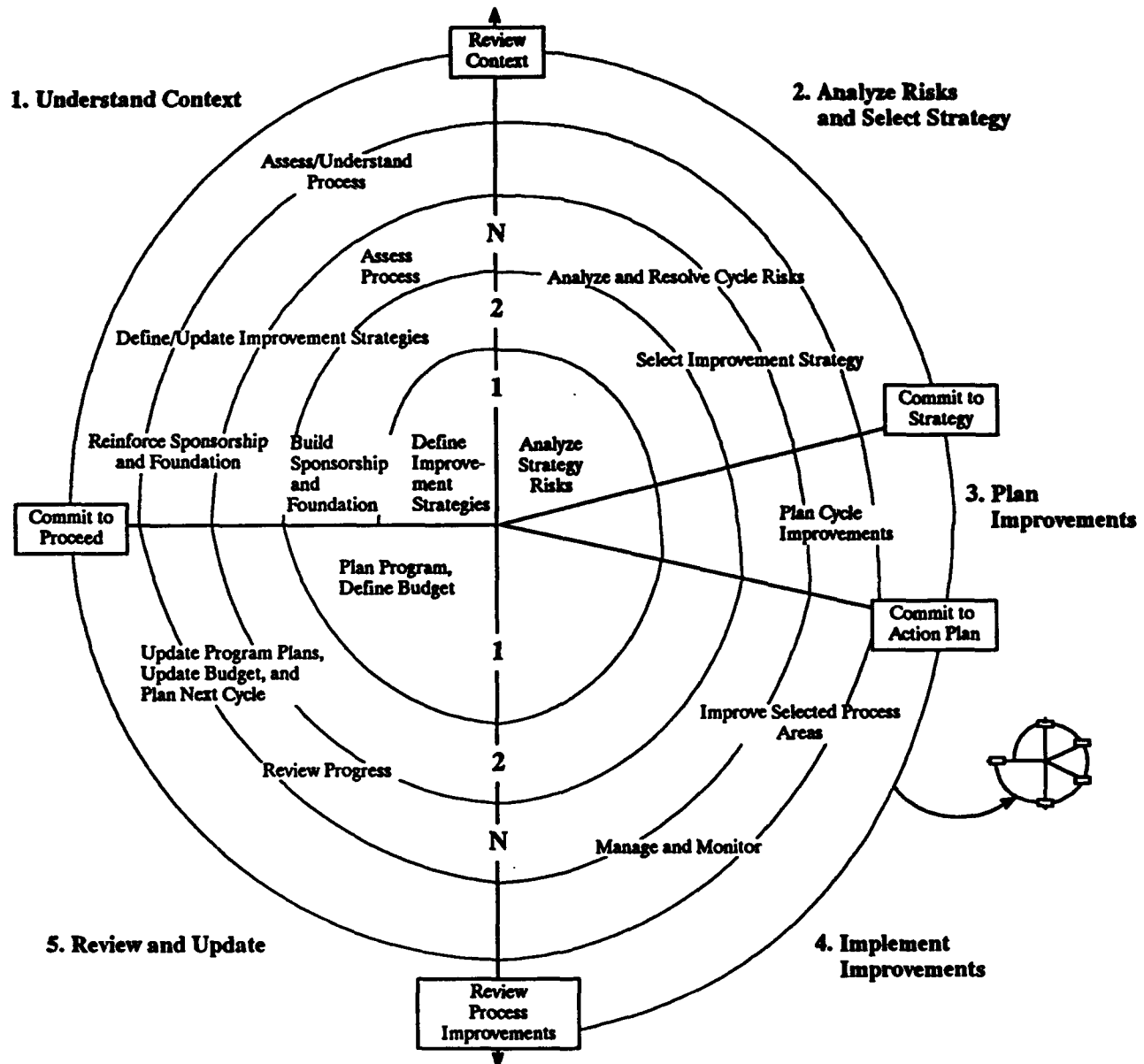


Figure 3-2. A Process Improvement Spiral

The next three sections provide a scenario for implementing Cycle 1, Cycle 2, and Cycle N (all subsequent cycles) to achieve your objective of process

improvement. Appendix A provides three checklists that support this scenario, and lists the activities and tasks that should be performed in each cycle.

CYCLE 1: DEVELOPING AN IMPROVEMENT PLAN

In the first cycle, the objective is to develop a plan for improvements that will be used in a later cycle to get management support and funding. The activities in the first cycle support this by:

- Defining alternative improvement strategies (Define/Update Improvement Strategies in Step 1).
- Analyzing the risks to the improvement strategy (Analyze Risks in Step 2).
- Skipping Steps 3 and 4 until sponsorship and support are established.
- Defining a plan for how to proceed (Plan Program and Define Budget in Step 5).

CYCLE 2: SECURING SPONSORSHIP

The objective of the second cycle is to secure management support for process improvement and to develop the needed infrastructure to proceed with improvements. The activities in the second cycle support this objective by:

- Obtaining explicit management support and funding, and confirming or establishing other roles for process improvement (Build Sponsorship and Foundation in Step 1).
- Analyzing and resolving risks, as needed, based on the sponsorship and infrastructure established in the first step (Analyze and Resolve Risks in Step 2).
- Skipping Steps 3 and 4 until sponsorship and support are established.
- Updating plans and budget, and planning the next cycle, when the first nonplanning activities will be performed (Update Program Plans, Update Budget, and Plan Next Cycle in Step 5).

If, at the start of the second cycle, management wanted changes to the plan before supporting it, then one or more cycles would be performed to incorporate these changes. As in any process improvement effort, however, do not proceed with implementation until management commitment and support are obtained. If management is committed from the beginning, then Cycles 1 and 2 can be combined.

CYCLE N: IMPLEMENTING PROCESS IMPROVEMENTS

From the third cycle on, the objective is to implement process improvements. By this time, a plan that everyone supports has been developed, and adequate management support and funding has been committed. In the third and subsequent cycles shown in Figure 3-2, each cycle is devoted to performing an assessment and focusing on improving those process areas deemed most critical to improve. The activities in these cycles support process improvement by:

- Reinforcing sponsorship and the supporting foundation, defining/ updating alternative strategies for the cycle and the entire process improvement strategy, if needed, and taking another look at the process (Reinforce Sponsorship and Foundation, Update Improvement Strategies, and Assess/Understand Process in Step 1)
- Analyzing and resolving risks for the current cycle and potentially the spiral, and selecting a strategy on which to base the cycle improvements (Analyze and Resolve Risks and Select Strategy in Step 2)
- Developing a detailed plan for the parts of the process to be improved in the current cycle (Plan Cycle Improvements in Step 3)
- Implementing the plan for this cycle, and monitoring and managing the improvements (Implement and Manage and Monitor in Step 4)
- Reviewing the progress of the cycle's implementation, updating all of the plans accordingly, and planning the next cycle (Review Progress and Update Program Plans, Update Budget, and Plan Next Cycle in Step 5)

3.3 USING THE PROCESS IMPROVEMENT PROCESS

This section explains how the process is described in subsequent sections of the guidebook and provides guidelines on how to use the process.

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LOCATING YOURSELF IN THE PROCESS

There are countless ways to perform process improvement using this process. Your role, your organization's culture, and the state of existing processes affect your focus and scope for these activities. Because of this wide range of possibilities, the guidance in this guidebook is based on the scenario outlined in Section 3.2.

Many situations deviate from the basic scenario outlined in this guidebook. Your organization may have:

- ***Existing Sponsorship and Commitment.*** You may already have a sponsor who is committed to process improvement. Do you have the infrastructure in place to support process improvement? Have you identified risks to process improvement? Is there an action plan for implementing process improvements?

Review the guidance for Cycles 1 and 2. Depending on your specific situation, you may need to perform some activities and tasks that are described in these cycles to identify risks to your process improvement program and develop a plan for implementing improvements. If you feel confident that you have addressed Cycle 1 and 2 issues, continue with Cycle N guidance.

- ***Recently Conducted an Assessment of Its Processes.*** In this case, you may need assistance with the steps following a process assessment. Is your sponsor still committed to implementing improvements? Is a Process Group (PG) in place, or do you need to establish one?

Review the guidance for Cycles 1 and 2 concerning the infrastructure and demonstrating sponsorship, and perform any activity you feel necessary. Follow the guidance for Cycle N in this guidebook for understanding your implementation risks, developing an action plan, implementing the plan, and reviewing progress.

- ***Lost Momentum in the Process Improvement Program.*** It is not uncommon for process improvement initiatives to lose momentum 16 to 18 months after a formal assessment. Has your sponsor seen incremental improvements? How has the organization and its climate changed, e.g., did a key stakeholder leave? Has the organization experienced down-sizing? Has funding been reduced?

Your best bet to reenergize the process improvement program may be to perform Cycle 1 and 2 activities again. You will need to work very hard to build sponsorship commitment and trust from the other stakeholders, since, historically, process improvement may have been perceived as less than successful. Sponsors are under tremendous pressure to show results, so set realistic expectations and implement small improvements to build trust within the organization.

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THINGS TO KNOW BEFORE USING THE PROCESS

Understand the following before you use this guidebook:

- The process guidance focuses on the group or individual implementing the improvement activities (the change agent).
- Sections 4 through 8 discuss process improvement primarily in proactive terms, though the activity descriptions are also useful when dealing with a reactive improvement process.

- You can perform each activity using various organizational structures and styles, including formal team meetings, informal group meetings, or work by individuals. How you perform each activity depends on your own style and your organization's culture.
- Many activities call for "a description of," instead of a specific documentation type. The document can be handwritten notes or word-processor text—the type of document you create is up to you and your management. You need to capture your analyses, decisions and supporting rationale, and implementation efforts.
- Each activity is accompanied by a list of potential measures that you can gather to improve your process improvement process. Calendar time, effort (i.e., staff hours, days, or months), size, and quality are the measures most commonly recommended. These measures provide a foundation for continuous process improvement, increase your accuracy in future estimation efforts, and help quantify your organization's return on investment (ROI).

When collecting effort data, record the amount of time spent by different levels of staff (i.e., a senior manager costs more than a staff engineer). These differences should be captured to reflect accurately the cost of an activity. The quality of intermediate work products (e.g., plans) may be best measured by using the inspection process.

- Use existing data and knowledge wherever possible, from such sources as planning exercises and process improvement experiences of your organization and peers.

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WHO SHOULD PERFORM THE ACTIVITIES?

Since staff at any level in your organization can play a role in process improvement, this guidebook defines these organizational roles. Identify your role(s) for any particular activity, and then follow the guidance for that role. The role icons to the left of the text (shown below with their respective role definitions) help to identify your role(s) quickly.

\$

- **Sponsor.** This person possesses sufficient authority or influence either to initiate resource commitment for process improvement (authorizing sponsor) or to reinforce process improvement efforts at the local level (reinforcing sponsor). Both authorizing and reinforcing sponsors continually legitimize and demonstrate ownership and commitment to process improvement. The departure or unavailability of sponsors could jeopardize the success of an improvement activity or group.

The authorizing sponsor is usually the senior manager of the organization and often serves as the chairperson of the Steering Committee (SC) of

the process improvement program. Reinforcing sponsors are typically at a middle-manager level and are members of the SC.



- **Change Agent.** This person or team is empowered by sponsors to implement and facilitate process improvement throughout the organization. The PG and the Process Action Teams (PATs) are considered change agents.



- **Champion.** This person advocates and publicly supports process improvement in the organization, but lacks the power to sanction it. A champion can be present at any and all levels of an organization; successful champions are usually respected for personal or technical leadership.



- **Process User.** This group of people uses the new process and is the focus of the change effort, i.e., the individuals are expected to change the way they work, and therefore their behavior or emotions. The process users are those people who develop your organization's software products, typically considered the technical staff.

These roles may evolve and overlap during process improvements. For example, a senior manager may need to be influenced by a champion or change agent to become an authorizing sponsor. Upon authorizing the proposed change, the sponsor may champion the improvement on a larger scale and to other organizations.

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HOW ARE THE ACTIVITIES FORMATTED?

Figure 3-3 presents the content and format of the activity descriptions that appear in Sections 4-8. Each activity description includes a cycle in the left-hand corner. For each activity, the corresponding step in the cycle context diagram is shaded. Context diagrams are also included in the page headers of Sections 4-8. They indicate the location in the cycle of the activity under discussion.

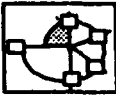


Name of Activity	
	A statement of when this activity is performed.
Overview	Provides an overview of the activity, including its objectives and any interactions with other activities.
Start Criteria	Provides entrance criteria and input descriptions.
Tasks	Provides a detailed description of the tasks that should be performed in this activity.
	A role icon is placed next to the first line of each task when the corresponding role will be involved in that task's performance. The guidance is written from the change agent's perspective.
<i>Cycle N</i>	The cycle in which you would perform this activity is indicated in the left margin as needed. In addition, the guidance includes how to perform this activity in this cycle.
Measures	Provides a description of measures that you should gather when performing this activity.
Stop Criteria	Provides exit criteria and output descriptions.
	

Figure 3-3. Activity Format

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4. ESTABLISH A BASELINE: UNDERSTAND CONTEXT

People will make reasonable decisions if they are given proper information.

Thom Serrani, Mayor, Stamford, Connecticut

Section Objective

Provide guidance for understanding your current organizational context

An effective process improvement program requires a reasonable understanding of the current status of the organization by everyone. The current status is a snapshot of both the technical aspects and the organizational/cultural aspects. This section provides guidance for the activities shown in Figure 4-1.

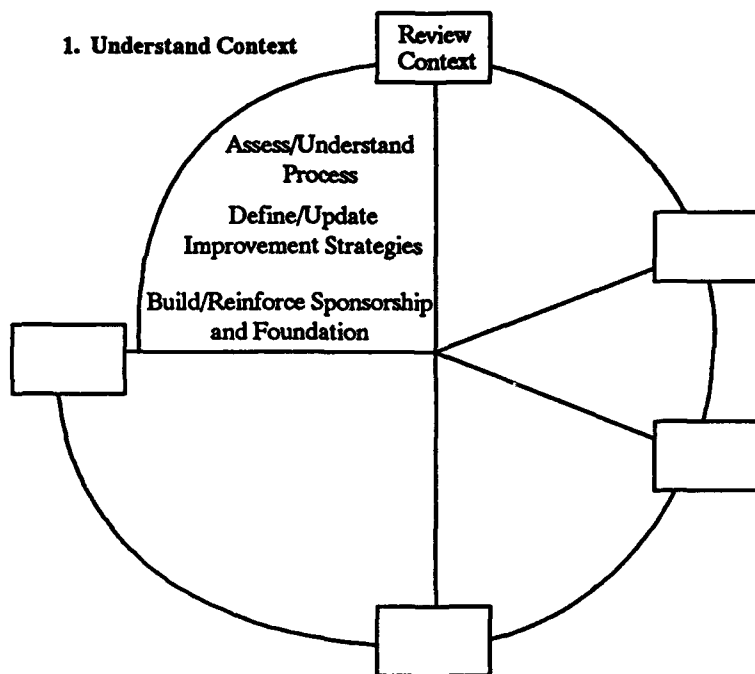
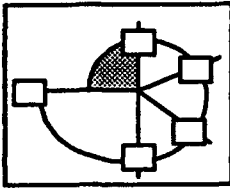


Figure 4-1. Understand Context Activities

4.1 BUILD/REINFORCE SPONSORSHIP AND FOUNDATION



OVERVIEW

This activity begins in Step 1, Understand Context.

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In this activity, your objective is twofold: to build and sustain strong sponsorship, and to create an organizational foundation, including culture, that supports successful continuous process improvement programs. This activity may be conducted in parallel with the next activity, Update/Define Improvement Strategies.

Success of a process improvement program is highly dependent on the commitment and support of senior management. Before launching a process improvement program, senior management must sanction the program and demonstrate this commitment to everyone in the organization by performing the “nondelegable” tasks described in this activity.

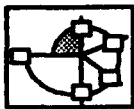
A process improvement foundation is required to support process improvements. This foundation includes organizational readiness, the SC, and the PG. Both of these groups represent the sponsors, champions, and change agents who support process improvements. Champions are needed to advocate process improvement and to keep people supportive by constantly reinforcing its benefits. Change agents are needed to perform the day-to-day tasks of support, implementation, planning, managing, and review. Sponsors must continually demonstrate and reinforce commitment.

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START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:

- Any supporting documents, including prior process improvement action plans and organizational strategic plans that are related to process improvement
 - If the organization is continuing process improvement, the planning documents created and updated in previous cycles, including the software process improvement plan, risk management plan, action plan, and influence strategy
 - Any historical process improvement information
-



TASKS

If you are a process user, champion, or potential change agent within your organization, and sponsorship is lacking, find someone who will sponsor process improvement. To do this, view the change as building management's awareness and belief in continuous process improvement. Perform Task 1 and Task 2 in Cycle 1 with this idea in mind until you have found an authorizing sponsor, and build intermediate or reinforcing sponsors continuously as you work toward this objective. Before sponsorship is established, the amount of resources you can expend on these two tasks will be limited and may be conducted on your own time. Perform them to the best of your ability.

Once sponsorship for process improvement has been established, perform these tasks in parallel with tasks in the Define/Update Improvement Strategies activity.

Understand that the tasks (except for Cycle 1 tasks) in this activity are nondelegable tasks—they must be conducted by the sponsor. Assist the sponsor in any way possible, but the message to the organization must come from the sponsor.



1. Understand Implementation Climate and Organizational Readiness. You need to understand the organization's history of process improvement and the readiness of all stakeholders to undertake process improvement. In this task, survey as many potential stakeholders as possible to understand their perceptions of the following:

- **Success of Past Process Improvement Initiatives.** Previous unsuccessful attempts at process improvement tend to decrease the credibility of the sponsors and increase the resistance in stakeholders.
- **Current Level of Stress in the Organization.** Stress within an organization can impact your process improvement program. Some sources of stress are positive motivating forces for the program, such as a lost contract opportunity, while some are less motivating, such as downsizing or a hostile takeover. Higher levels of stress require more resources to manage and implement process improvement successfully.
- **Culture of the Organization.** Process improvement efforts that are aligned with the organizational culture have a greater chance of success than those that are not. When improvement efforts are counter to the existing culture, the culture always prevails.
- **Degree and Type of Commitment of Sponsors.** The degree and type of commitment of executives, senior management, and middle management are important indicators of improvement success.

\$ Sponsor

 Champion

 Process User

 Change Agent



- **Concerns of the Process Users.** Resistance is inevitable. Listen to and understand process users concerns about the change and its consequences, so that you can better manage their expectations.
- **Ability of the Change Agents.** These people must have the proper skills, respect, support, and responsibility to be effective in their positions. One key skill that is needed is a deep understanding of human reactions to change.

A general rule of thumb is that if the climate is strong (good history and low stress), then fewer resources will be needed to build organizational readiness (culture, sponsors, process users, and change agents). Conversely, if the climate is weak (poor history and high stress), you will need more resources to build organizational readiness. The information gathered in this task is used in Task 2.

Cycle 1 At this point in the process, you will have limited resources (time, money, people) to expend on performing this task. The methods you use to gather this information will be informal and nonintrusive in nature. It is too early in the process to know specifics about what will change, so concerns of the process users and ability of the change agents cannot be gauged at this time.

Cycle 2 Once you have identified a strong sponsor, more resources may be used to gather this information. The methods you use will be more formal and, ideally, quantitative in nature. It may be wise to get an external consultant with expertise in organizational change to perform this task.

If the organizational climate is not conducive to change, or the readiness of the stakeholders is low, consider these as risks to your process improvement program and address them in the next step of the cycle.

Cycle N If a change has occurred in your organization that would affect its readiness, you may need to reassess these factors. For example, if your sponsor leaves the organization and a replacement is brought in, this may affect not only the perception of sponsor commitment, but also organizational stress.



2. Prepare and Execute Influence Strategy. To maximize the probability of successful process improvements, you need to develop an influence strategy to communicate to the organization what process improvement is, why it is needed, what it will be like after the improvements are made, what path you will take to get there, etc. Perform the following subtasks:

- **Define Change and Identify Stakeholders.** For all the roles in process improvement, identify why they should support process improvement, what the change will mean to them, and what will not change, and the

\$ Sponsor



Champion



Process
User



Change
Agent



potential people in the organization who will fall into that role. Figure 4-2 shows a sample matrix that can be used to gather this information.

	Sponsor	Change Agent	Process User	Champion
Who				
What				
Why				

Figure 4-2. Define the Change in Stakeholder's Frame of Reference

As you identify what will and will not change, remember to consider the stakeholder's frame of reference. By understanding the point of view of the stakeholder group, you can identify potential resistance.

Another way to identify stakeholders is to obtain a current organization chart and, using four or five different highlighter colors, identify the sponsors (both authorizing and reinforcing), champions, change agents, and process users.

- **Develop Sponsor Profiles.** For all potential authorizing and reinforcing sponsors, from most senior management to immediate supervisors of process users, gather the following information:
 - What is their attitude toward process improvement? What is their awareness of process improvement activities and resources required?
 - To whom do they report? Whom do they go to for counsel? Who goes to them for counsel? Does anyone in the process user group influence them?
 - What about process improvement might interest them?
 - What is their communication style? Are they ROI-driven? technology-driven? people-driven?
 - Where are the sponsors, both authorizing and reinforcing, located on the organization chart? Where do the potential process users, champions, and change agents fit, in relation to the sponsors?

Rank the list of sponsors (both authorizing and reinforcing), from the easiest from whom you are likely to gain buy-in to the most difficult.

- **Understand Stakeholder Relationships.** A successful influence strategy will take into consideration the relationships among the stakeholders.

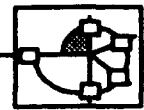


Figure 4-3 shows three common stakeholder relationship scenarios (Conner 1993). Which scenario best reflects your situation?

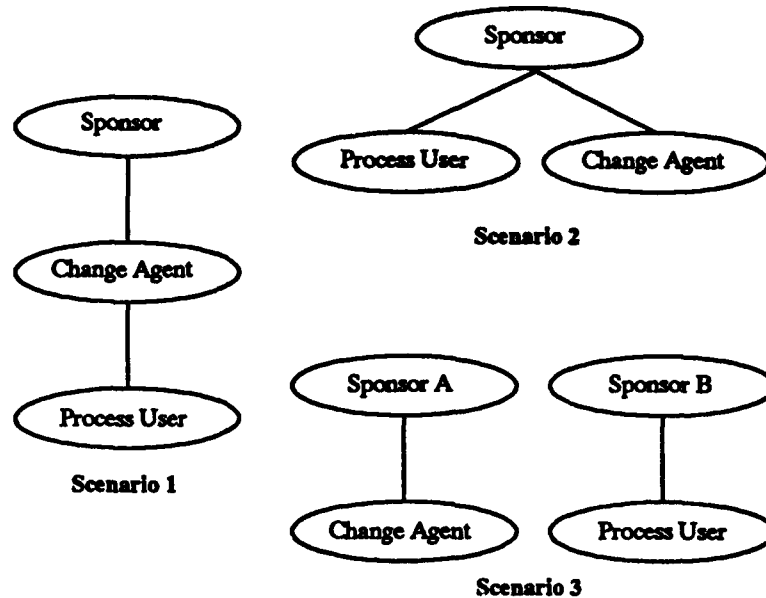


Figure 4-3. Role Relationships

- **Scenario 1.** This is the typical hierarchy organization. The sponsor may successfully cascade some of his sponsorship duties to the change agent. The process users view the change agents as extensions of the sponsors.
- **Scenario 2.** If the sponsor delegates sponsorship duties to the change agents, the process users are more apt to resist. For this structure to be successful, the sponsor needs to emphasize his commitment to process improvement and introduce the change agents as the group chosen to guide the process improvement efforts. This demonstrates unequivocal commitment and reduces resistance.
- **Scenario 3.** This structure poses a challenge. If the sponsor (Sponsor A) and the change agents want any glimmer of success, they must convince the process users' sponsor (Sponsor B) that process improvement is imperative. Until then, resistance will occur.

Examining an organization chart is one way to understand relationships, but most communication occurs in a less formal structure. It may be helpful to develop advice, trust, and communication relationship networks, as described by Krackhardt and Hanson (1993).

- **Develop an Influence Strategy.** With all the information gathered above, develop a "sales pitch," using the most appropriate means in your organization (e.g., presentation, white paper, electronic mail, newsletter) to communicate with the stakeholders. Support from the stakeholders will not occur without such communication. This strategy should include:



- Motivation section to help the stakeholders unfreeze
- Vision of the desired state, i.e., what the organization will “feel” like after improvements are made
- Outline of the transition steps to achieve the vision

Figure 4-4 shows two graphics, based on the three-stage model of change shown in Figure 2-4, that can be used to summarize the information you put into your influence strategy.

- Cycle 1** Your main focus in this cycle is to develop an influence strategy to convince someone in senior management (a potential sponsor) that process improvement is valuable and worthy of resource investment. Spend most of your time identifying potential authorizing and reinforcing sponsors. Begin informing some process users of the process improvement effort. Be selective in the amount of information you share and with whom; you want to decrease the possibility of someone sabotaging your efforts before you have gotten off the ground.
- Cycle 2** Once you have identified a sponsor, focus on cascading sponsorship (from senior management to process user supervisors) and establishing buy-in from all stakeholders in the organization, especially process users. The influence strategy you use here can be used in the subsequent task of demonstrating sponsorship and commitment.
- Cycle N** As you learn more about each stakeholder group in your organization, it may be necessary to revise your influence strategy. Not only can you use this influence strategy within your organization, you can use it to influence your parent or peer organization.



3. Demonstrate Sponsorship and Commitment. Sponsors can demonstrate commitment by performing the following nondelegable actions:

- **Set Challenging Goals to Ensure Process Improvement.** It is crucial for senior management to set reasonable, challenging goals. These goals should be attainable, but the organization should have to “stretch” moderately to meet them.
- **Provide Necessary Resources.** Sponsors need to invest in learning and communication. Brown-bag lunches, guest speakers, or video presentations are means for an organization to raise the level of awareness and start to communicate better. Briefings should be conducted periodically to inform personnel of the progress of the process improvement activities.

\$ Sponsor



Champion



Process
User



Change
Agent

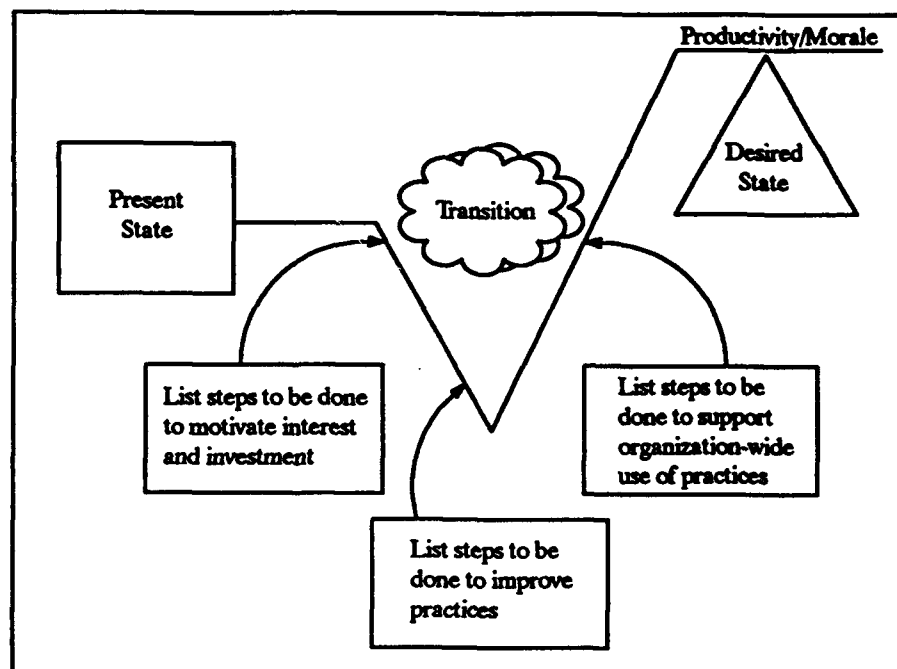
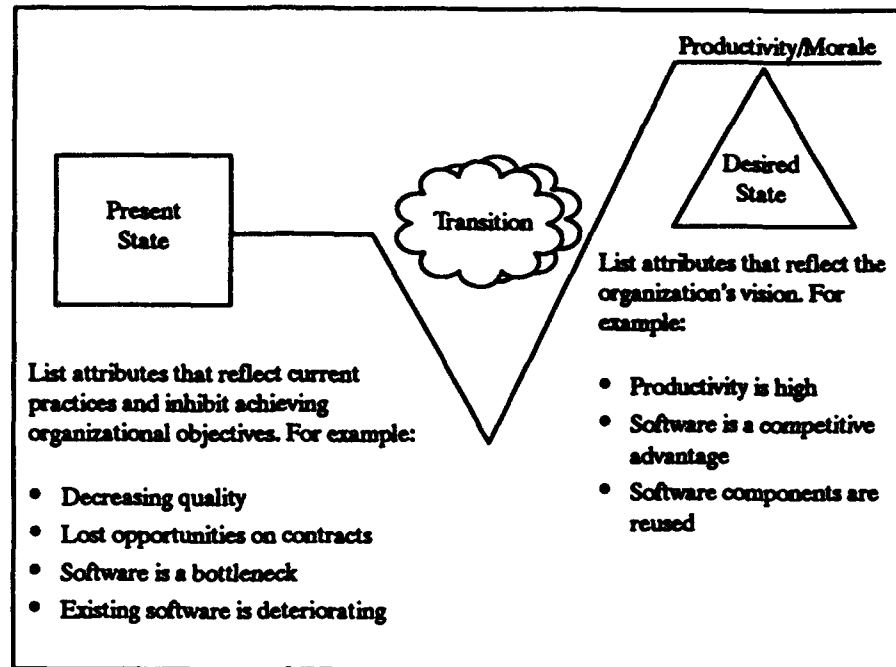
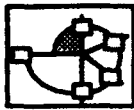


Figure 4-4. Graphics for Communicating Change

- **Monitor Progress.** Senior management can provide visible support and maintain the seriousness of the program by monitoring its progress.
- **Reward Success, But Do Not Punish Failure.** The purpose of process improvement is to fix the process, not the people. Reward those who contribute to the process improvement efforts. Look upon



less-than-successful efforts as valuable lessons learned. Punishment only serves to stifle people's motivation and involvement.

- **Build a Culture of Improvement.** Sponsors should create an atmosphere of continual change and improvement. The organization that becomes adept at handling change is better poised to continue to improve the way it does business and to remain successful and competitive in its market.

Cycle 1 A sponsor has not yet been identified to perform this task.

Cycle 2 Use the influence strategy created in the previous task as a vehicle to demonstrate commitment. Communicate this influence strategy to the organization stakeholders. Pick three to five main points of the influence strategy (such as the existing state, the desired state, and the costs of not changing) and mention these when talking to anyone in the organization about process improvement. Short, consistent messages help to demonstrate commitment and build trust in the stakeholders.

If you doubt whether sponsorship can be sustained throughout the improvement cycle, do not proceed any further. Instead, execute another cycle, focusing on strengthening sponsorship.

Cycle N Continue to reinforce the importance of process improvement by using the influence strategy. Also stress the progress made to date and the resulting benefits.

\$



4. Form a Steering Committee. The role of the SC is to guide process improvement in the organization, based on the knowledge of its members of high-level organizational issues. This committee cannot be formed until a sponsor has been identified.

Membership of the SC should consist of the sponsor, middle managers from each major software group or division within the organization, and the PG leader. The SC should meet on a regular basis, either monthly or quarterly, and provide progress reports to the overseeing manager. The responsibility of the SC chair should be rotated on a periodic basis among the members, but initially the senior manager is the chairperson.

See Section 6, Chart a Course: Plan Improvements, for specific details on the duties of the SC.

Cycle 1 A sponsor has not yet been identified to perform this task.

Cycle 2 Involve the SC early in subsequent planning and commitment activities. Since the SC is considered a sponsor, its members should, as do other

\$ Sponsor



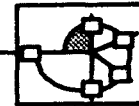
Champion



Process
User



Change
Agent



sponsors, promote the same three to five key points from the influence strategy.

Spend time on building a strong, dynamic team to increase its effectiveness. This group is very visible and should demonstrate sponsorship. If the team is perceived as ineffective or dysfunctional, the process improvement program will not be perceived positively.

Cycle N

At the start of each cycle, evaluate membership on the SC for fit to the focus of the current cycle. Consider rotating the chairperson role so that others can be seen as a sponsor and leader. As members leave the SC, recognize and reward their efforts and contributions. This acknowledgment may be as simple as a plaque for outstanding contribution or a monetary reward.

If there is a turnover in SC members, perform some additional team building exercises to set the stage for the new members. Refer to Scholtes (1988) for guidance on team building exercises.

\$



5. Establish a Process Group. This group cannot be formed until a sponsor who fully supports the process improvement has been identified. The PG is the focal point for software process improvement and works with managers and engineers to improve the process capability of an organization. The PG should report to senior management, through the SC, and should be recognized as having authority to effect change.

The recommended PG staffing level should be between 1% and 3% of the software engineering department. Staffing can be done by permanent assignment, part-time assignment, temporary assignment, or a combination of these. There needs to be at least one permanent member of the PG, however, to maintain continuity and focus. The permanent member is considered the PG leader.

The suggested guidelines for selecting the PG leader are:

- *Recognized as a Leader Within the Organization.* This person is the liaison among senior management, middle management, and the process users.
- *Experienced in All Phases of Software Development.* This person must have a clear, detailed understanding of the organization's process and practices.
- *Advocate of Process Improvement and TQM Principles.* Senior management and engineers (process users) within the organization may continuously challenge or resist process improvement activities. The PG leader needs to reaffirm the importance and value of process improvement.

\$ Sponsor



Champion



Process
User



Change
Agent



- **Team Leader or Participant in the Process Assessment.** Ideally, the PG leader functions as the leader of the process assessment team, thus demonstrating leadership to the organization.
- **Experienced in Project Management.** The PG leader is the main focal point for overseeing the process improvement steps. The PG leader also coordinates and manages the activities of the PATs.
- **Strong Team Building and Team Dynamics Skills.** The PG leader works with groups that are formed to assist in process improvement activities.

Other members of the PG should be practicing software professionals. They may have development or support roles. The current focus of the PG is to provide guidance for selecting the skill sets these members need to possess. For example, if the current focus of the PG is improving project management practices, then its members should have a good understanding of project management concepts and principles.

A PG could potentially exist at many layers in an organization, depending on its size and organizational structure. Typically, there is one PG per functional organization, i.e., an organization whose products are built for one functional area, such as Management Information Systems and real-time embedded systems. You may also have a PG for each project within an organization or a PG across several functional areas, though these are less common. Things to consider when several PGs exist: Does each have a clear purpose (charter), or will they be stepping on each other's toes? Whom do they report to? What are their spheres of influence?

See Section 6, Chart a Course: Plan Improvements, for specific details on the PG's duties.

Cycle 1 In Cycle 1, you have not identified a sponsor, so a PG cannot be formed.

Cycle 2 Involve the PG (change agents) early in subsequent planning and commitment activities. Since the PG is the main focal point for process improvement implementation, its members should, as do other sponsors, promote the same three to five key points from the influence strategy. The sponsors should formally recognize and introduce to the organization the members of the PG.

Spend time on building a strong, dynamic team to maximize its effectiveness. This group is very visible, it has been sanctioned by senior management to implement process improvement. If need be, provide the members of the PG with communication and consulting skills training. If the team is perceived to be ineffective or dysfunctional, the process improvement program will not be perceived positively.

Cycle N At the start of each cycle, evaluate the membership of the PG in terms of fit to the current cycle focus. The PG leader role may be rotated, but beware of



too frequent rotations; you may lose continuity from one cycle to the next. As members leave the PG, recognize and reward their efforts and contributions. This acknowledgment may be as simple as a plaque for outstanding contribution, a monetary reward, or promotion. This both demonstrates to others that you value the efforts of the PG and encourages members of the group to become more actively involved with process improvement.

If there is a turnover in PG members, perform some additional team building exercises to set the stage for the new members. Refer to Scholtes (1988) for guidance on team building exercises.

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MEASURES

In order to quantify resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:

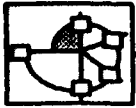
- Time and effort spent understanding the implementation climate and organizational readiness
- Size of organization, in persons and organizational units
- Time and effort spent developing an influence strategy
- Size of influence strategy (e.g., pages or charts)
- Quality of the influence strategy
- Size of the SC
- Size of the PG
- Cost of external consultant engaged to assist with understanding the implementation climate and organizational readiness, if any

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STOP CRITERIA

This activity is complete when:

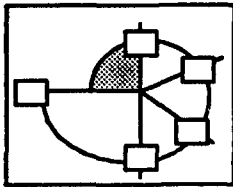
- You have prepared an influence strategy and documented it in the form most appropriate for your organization, possibly a presentation or white paper
- You have secured adequate sponsorship to support process improvement
- You understand the current climate of the organization



- You understand the level of stakeholder readiness for process improvement
- Both the SC and PG have been established

If you doubt whether sponsorship can be sustained throughout the improvement cycle, you have two alternatives. First, you could execute another cycle, focusing on strengthening sponsorship. Second, if your sponsor is willing to commit to a formal software process assessment, then you could proceed and use that assessment to solidify sponsorship. If you choose to proceed with an assessment without adequate sponsorship, you increase the risk of implementation failure, which incurs both short-term costs, such as wasted resources, and long-term costs, such as reduced confidence in leadership.

4.2 DEFINE/UPDATE IMPROVEMENT STRATEGIES



OVERVIEW

This activity begins in Step 1, Understand Context.

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In this activity, your objective is to define and update the process improvement program objectives, alternatives, and constraints that are consistent with the needs and current environment of your organization. Once the process improvement program has sponsorship, you will develop the objectives, alternatives, and constraints for the current cycle.

Before you can define your process improvement strategy, you need to understand the environmental issues that may influence the process improvement program. Alternatively, you may provide some retrospective validation for decisions that have already been made. Document your findings and justifications for recommendations in this activity, many of the issues and concepts change rapidly or are perceived differently by different people.

With the information identified in this activity, you can influence stakeholder expectations about the purpose of the process improvement program, as well as the purpose of the current cycle. For this reason, you may choose to perform this activity in parallel with the previous activity, Build/Reinforce Sponsorship and Foundation, during Cycles 1 and 2.

In Cycle N, this activity is typically performed after an assessment of the current state of your organization's software process. This allows you to customize the cycle objectives to the findings and recommendations from an assessment.

.....

START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:

- Internal environment information, including any strategic plans, process improvement documents, and analysis of your organization's work force (e.g., demographics, skills)
- External environment information, including existing organizational documents on processes and technologies (e.g., trip reports, benchmark studies), market surveys, comparison data with peer organizations, competitor information, and relevant laws, regulations, or standards



- If you are involved in a continuing process improvement, the planning documents created and updated in previous cycles, including the process improvement plan, risk management plan, action plan, and influence strategy
- The findings and recommendations report from the most recent assessment
- Any historical process improvement information

.....

TASKS

You will define or update your process improvement program objectives, as well as your cycle objectives, identify alternative ways to meet your objectives, and identify constraints on your process improvement program.



1. Define/Update Objectives. An objective is an intended or desired result of a course of action. It is better to write several independent objectives than to pack everything into one statement; this facilitates progress review and simplifies tradeoff analysis. A rule of thumb is that each objective may be met independently of the success or failure of any other objective.

These are some characteristics of a good objective:

- ***Meets Stakeholder Win Conditions.*** The objective reconciles conflicting expectations and creates reasonable winning conditions for all.
- ***Results Oriented.*** The objective describes the desired result, not the means to achieve it.
- ***Trackable.*** Progress toward the objective is determined by tracking measurable goals that support the objective.
- ***Clear and Concise.*** The objective can be stated in 20 or fewer words.
- ***Controllable.*** It is possible to influence how, whether, and to what degree the objective is met.
- ***Realistic.*** It is possible to achieve the objective, given current information and resources.
- ***Appropriate.*** The objective is well suited to the current level of abstraction.



Sponsor



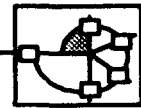
Champion



Process
User



Change
Agent



Cycle 1 Identify your organization's strategic objectives of process improvement, such as "achieve maturity Level 3 within two years" or "achieve a tenfold increase in quality, as perceived by our customers, in five years." Base these objectives on your perception of senior management's objectives.

Your cycle objectives will focus on both creating a process improvement program strategy and estimating the amount of resources needed to undertake process improvement activities.

Cycle 2 Work with your (potential) sponsor and the SC to refine your organization's strategic objectives for process improvement.

Your cycle objectives will focus on identifying the key roles of process improvement and potential stakeholders to perform these roles, as discussed in the Build/Reinforce Sponsorship and Foundation activity.

Cycle N Update, if needed, the organizational objectives for the process improvement program, based on feedback from the sponsors and any findings from an assessment.

Your current cycle objectives will typically focus on improving part(s) of your software process, based on the major areas of improvement from the assessment recommendations. For example, you may identify five cycle objectives:

- To improve software project management practices
- To improve requirements management practices
- To formalize review processes
- To institutionalize software quality assurance practices
- To install configuration management practices



2. Identify Alternatives. Identify various ways to achieve your objectives. Document the following information for each alternative identified:

- An outline that discusses how the alternative might accomplish the objectives
- Any interdependencies among the alternative and other previous alternatives that may have been committed to
- An estimate of the resources (e.g., people, information, time, materials, equipment) required by the alternative

\$ Sponsor



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Process
User



Change
Agent



- An estimate of the confidence (lack of risk) in the estimates
- An estimate of any additional benefits and/or opportunities

Cycle 1 Consider all viable alternatives to attaining your strategic objectives. For example, if your strategic objective is to “achieve a tenfold increase in quality, as perceived by our customers, in five years,” your alternatives may be to institute a reuse adoption program, institute TQM principles, and improve process maturity using the CMM.

In Cycle 1, your cycle objective is to develop a plan that you will use to establish sponsorship.

Cycle 2 Work with your (potential) sponsor to identify any other alternatives for achieving your organization’s strategic objectives for process improvement.

Your cycle alternatives will identify ways to understand and/or assess your process. Your alternatives may include conducting a formal assessment of your organization and performing a less rigorous appraisal of a smaller part of your organization or process. Refer to Appendix B for information concerning various ways of assessing and understanding your software process.

Cycle N Assuming your program objectives have not changed significantly, identify and document any viable alternative ways to implement your cycle objectives.

For example, you may identify, at a very high level, the scheduling and resource assignment alternatives, shown in Figure 4-5, for achieving the five cycle objectives identified in Task 1.



3. Identify Constraints. Constraints are unchangeable considerations that alternatives must satisfy. Your constraints may come from:

- **External Influences.** Your organization may be part of a larger business organization that imposes expectations and constraints. The customer may also pose constraints on your organization.
- **Limited Resources.** Your organization may be limited by its availability of skilled personnel, development time, and available funding.
- **Existing Technology.** Your organization may be bound by existing technologies, such as reusable parts, commercial off-the-shelf (COTS) products, and software development methods.
- **Standards.** The parent organization or a customer may impose standards to follow and/or activities to conduct.

\$ Sponsor



Champion



Process
User



Change
Agent



Alternative 1

1.	PAT 1
2.	PAT 2
3.	PAT 3
4.	PAT 4
5.	PG

Alternative 2

1.	PG
2.	PAT 1
3.	PAT 2
4.	PAT 3
5.	PAT 4

Alternative 3

1.	PAT 1
2.	PAT 2
3.	PAT 3
4.	PAT 4
5.	PAT 5

Figure 4-5. Scheduling and Resource Assignment Alternatives

Cycle 1 Identify and document constraints on your alternatives to achieve your strategic objectives.

Cycle 2 Your constraints during this cycle typically reduce the number of software process assessment alternatives to one.

In most instances, certain constraints on your assessment methods narrow down your alternatives to just one. For example, your organization may have a contract with a requirement to demonstrate CMM Level 3 characteristics, or you may be competing in Europe and must be compliant with the ISO 9000 standards.

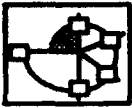
Cycle N Review the constraints on your process improvement program and update, as needed. Identify and document the constraints on your cycle alternatives.

If your process improvement program is new or revitalized, you may want to constrain your cycle objectives to one or two process area improvements. This provides you the opportunity to achieve one or two small successes, which increases stakeholder buy-in and commitment.

.....

MEASURES

In order to quantify resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:



- Time and effort spent defining and updating your objectives
- Time and effort spent identifying alternatives
- Time and effort spent identifying and reviewing constraints
- Number of objectives, alternatives, and constraints that are new, modified, or reused as is

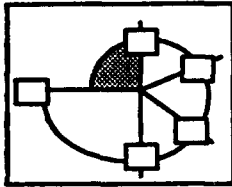
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STOP CRITERIA

This activity is complete when:

- You have prepared a description of your organization's objectives and constraints for the process improvement program and/or for the cycle. These objectives and constraints are based on a current understanding of your external and internal environments.
- You have prepared a description of alternative strategies for achieving your cycle objectives.
- In the first cycle, you have identified alternative process improvement strategies that should be considered for the program.

4.3 ASSESS/UNDERSTAND THE PROCESS



This activity begins in Step 1, Understand Context.

.....

OVERVIEW

Your objective in this activity is to conduct an assessment of the organization's processes to identify and understand the critical software issues. The main objectives of a software process assessment are:

- To understand how the organization operates
- To identify key areas for improvement
- To enlist organization stakeholders in the change process

You will use the assessment strategy selected in the previous cycle in Step 2, Analyze Risks and Select Strategy.

None of these tasks are performed until you have achieved sponsorship and received approval on the improvement program strategy defined in previous cycles. Therefore, all of the guidance in these tasks is indicated to be done only in Cycle N.

If you have initiated or performed an assessment prior to establishing the needed foundation (i.e., the SC or PG), refer to the Build/Reinforce Sponsorship and Foundation activity for guidance on establishing these groups.

.....

START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:

- Selected assessment method
 - Internal environment information, including organizational and project policies and procedures, and process definition documents
 - Any historical process improvement information
-

TASKS

In this activity, you will gain an understanding of the software processes your organization currently practices.



1. Assess/Understand Your Organization's Current Process. Every software organization, regardless of size or maturity, has a process for developing and maintaining software. Before improvements can be made, you must have a clear understanding of your current software process.

If your process improvement program is just beginning or needs reinvigorating, it is best to have an external vendor lead the assessment. This provides the following benefits:

- Independent view from someone who is unbiased and an expert in the chosen assessment method
- Guidance and insight into how to implement the assessment method, including planning
- Demonstrated commitment since the sponsor is willing to invest resources (time, money, people)

Formal assessments are relatively expensive and should be conducted when you expect findings and recommendations to be formulated that are significantly different from the status quo.

If your process improvement program is in full swing, you may not want to expend the level of resources required by a formal assessment. Instead, you may be able to compare the recommendations from the previous assessment to the improvements that have been implemented and ascertain, objectively, what areas need to be worked on next. Be aware of any organizational or process changes that have occurred in the time period since the formal assessment, so that you can determine if your conclusions are still valid.

Regardless of the degree of formality you choose, you may want to initiate a new spiral focused specifically on implementing a process assessment.

Refer to Appendix B for a description of three different process assessment methods.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Execute the steps in the method that you selected to assess and understand your process. Develop a set of findings, based on the information gathered. If several findings are similar in nature, you may want to group them into one category with several sub-findings. This task typically concludes with a short presentation to your sponsor on the findings of the assessment.

Refer to Appendix C for an annotated outline of a findings presentation.

\$ Sponsor



Champion



Process
User



Change
Agent



2. Identify Recommendations for Improvement. Base the recommendations both on the findings from an assessment or appraisal and on any other organizational issues that you feel are imperative to improve.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Categorize the recommendations into logical areas for improvement. Within each one of these major areas, identify the focus of improvement. For example, if an assessment found that no documented practices existed for project planning, the focus for the project planning area would be to develop policies and procedures for project planning. If policies and procedures were found to exist, the focus might be on training and institutionalizing those project planning practices.



3. Develop a Findings and Recommendations Report. Once you have developed findings and recommendations, you need to capture this information in a report. This task, along with Task 2, should be completed within four to six weeks after the conclusion of Task 1.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Develop a report to be presented to your sponsors. You do not need to present great detail in this report, since it will be incorporated into and expanded in the action plan produced in Step 3, Plan Improvements.

Refer to Appendix D for an annotated template of a findings and recommendations report.



4. Present the Recommendations. The recommendations presentation supports the findings and recommendations report and should be conducted soon after the completion of the report (Task 3). Include the findings in your presentation to provide context for each recommendation and to jog memories.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Present the recommendations to your sponsors. Encourage your sponsors to invite all the stakeholders in the organization. This will demonstrate to the stakeholders that the sponsors are serious about process improvement and that they do not want to keep anything hidden.

Refer to Appendix E for an annotated outline of a recommendations presentation.

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\$ Sponsor



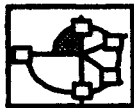
Champion



Process
User



Change
Agent



MEASURES

In order to quantify resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:

- Time and effort spent on planning for a process assessment or other appraisal
- Time and effort spent on implementing an assessment or other appraisal
- Number of findings and recommendations
- Time and effort spent developing the findings and recommendations report
- Size of the findings and recommendations report (i.e., number of pages)
- Quality of the findings and recommendations report
- Costs incurred for an external consultant to conduct a process assessment
- Costs incurred for any tools used to support an assessment or other appraisal of your process

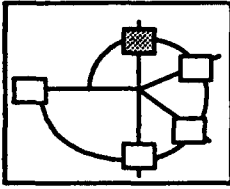
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STOP CRITERIA

This activity is complete when:

- You have prepared a description of the findings that were derived from an assessment or appraisal of your organization's processes
- You have prepared a description of recommendations made by the assessors to address the assessment findings

4.4 REVIEW CONTEXT



This activity begins in Step 1, Understand Context.

.....

OVERVIEW

Your objective in this activity is to achieve agreement on the current state of the organization, as you understand it. Consensus should be reached on the objectives, alternatives, and constraints for both the process improvement program and the current cycle, as well as on the findings and recommendations from a software process assessment.

.....

START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:

- Alternative strategies for the process improvement program and for the cycle
 - Understanding of the current process to be changed, including findings and recommendations
 - Understanding of who are the stakeholders for this review
-

TASKS

In this activity, you will obtain agreement from stakeholders other than the sponsors on the current organizational context, including any findings and recommendations, receive approval from the sponsors on the alternative strategies, and publicize the commitment to continue to the next step.



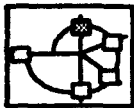
1. Obtain Agreement From Change Agents, Champions, and Process Users. Seek agreement first from all stakeholders other than the sponsors. What may change from cycle to cycle for this task are the people who are the change agents, champions, and process users.

\$ Sponsor

 Champion

 Process User

 Change Agent



- Cycle 1** You will seek agreement on your understanding of the organization's climate and readiness for change and the strategy to improve the process. While it is better to have strong support early on, remember that some people will resist change, especially when there is no sponsor. Do not get hung up in trying to get everyone's full agreement. Identify those who do agree; they can become champions later in the process. Pay attention to the grumbling you hear; the causes may become barriers (risks) in Cycle 2.
- Cycle 2** Again, you will seek agreement on your understanding of the organization's climate and readiness for change and the strategy to improve the process. This information may have changed from Cycle 1, based on discussions with potential sponsors. Typically, the community that you include in this review will be larger than that in Cycle 1.
- Cycle N** In later cycles, you will seek agreement on the cycle strategy and the findings and recommendations that result from an assessment or appraisal of your processes.



2. Obtain Approval from Sponsors. After you have buy-in from champions, change agents, and process users, present your recommendations to the sponsors for approval. Your presentation should include:

- Description of the program and cycle objectives, alternatives, and constraints
- Your recommendation(s) for the next steps (typically execution of the remaining cycle steps)
- Your rationale for the recommendation
- Impact anticipated of the recommendation on the organization, especially the impact on each sponsor's group
- Estimated cost and time frame for the recommendation

Depending on your situation, you may decide to stagger the presentations, addressing first those sponsors who are more supportive, in order to build a stronger case for those sponsors who are less supportive.

You may have to go through several iterations of your presentation to management before you get a final decision to go ahead with the implementation. If so, return as necessary to any task in this activity or in the Analyze and Resolve Risks or Select Strategy activities in order to secure the decision to proceed.

\$ Sponsor

 Champion

 Process User

 Change Agent



Cycle 1 This task is not performed until adequate sponsorship is established.

Cycle 2 Review the process improvement program strategy with your authorizing and reinforcing sponsors. You may need to modify the program strategy, based on any changes recommended by the sponsors.

Cycle N In later cycles, you will seek approval on the cycle strategy from your authorizing and reinforcing sponsors.

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3. Publicize Commitment. After approving the recommendation(s), the sponsors need to publicize their support and commitment throughout their organizations to keep everybody informed, to reinforce the importance of process improvement, and to help prepare everybody for the changes ahead.

Cycle 1 This task is not performed until adequate sponsorship is established.

Cycle 2...N Assist the sponsors with publicizing commitment to process improvement. Use the influence strategy created in Step 1, Understand Context.

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MEASURES

In order to quantify resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:

- Time and effort spent reviewing the current organizational context with change agents, champions, and process users
- Number of persons interacted with during the review
- Time and effort spent developing a management presentation
- Size of the management presentation (e.g., number of charts)
- Quality of the management presentation
- Time and effort spent meeting with sponsors
- Number of presentations to and meetings held with sponsors

\$ Sponsor



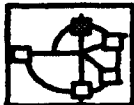
Champion



Process User



Change Agent



- Time and effort spent publicizing commitment
- Number of persons to whom and places where commitment was publicized

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STOP CRITERIA

This activity is complete when you have achieved both agreement on the program and cycle context from all identified stakeholders and commitment from the sponsor to proceed.



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5. LOOK BEFORE YOU LEAP: ANALYZE RISKS AND SELECT STRATEGY

Wisdom consists in being able to distinguish among dangers and make a choice of the least harmful.

Niccolo Machiavelli, *The Prince*

Section Objectives

1. Provide guidance for analyzing and resolving risks associated with process improvement

2. Provide guidance for selecting a strategy for process improvement

After identifying the context in which you are performing the process improvement, you first perform risk analysis to help identify, address, and eliminate risk items before they become threats to the success of process improvement activities, and then take action to minimize or eliminate them. Based on your risk analysis and mitigation, you will select an improvement strategy for the remainder of the cycle. This section provides guidance for the activities shown in Figure 5-1.

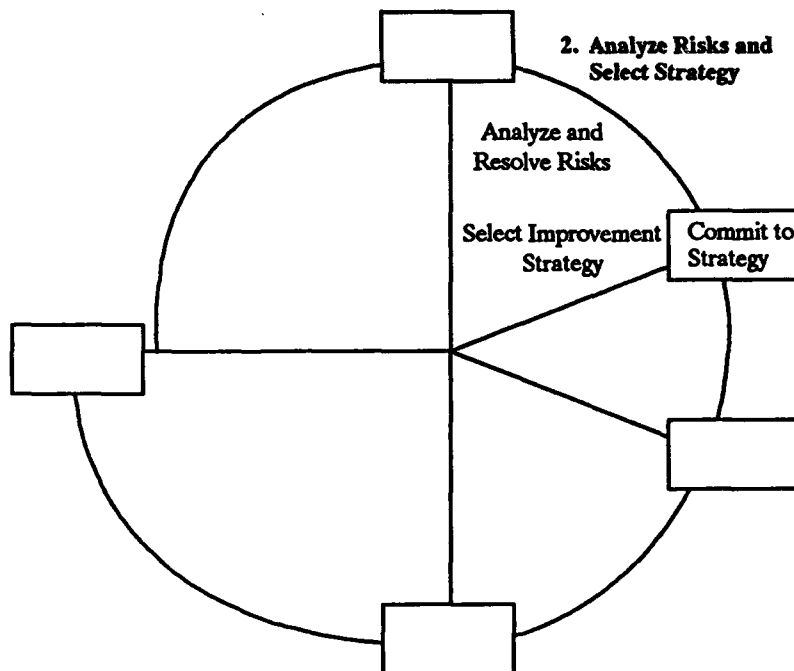
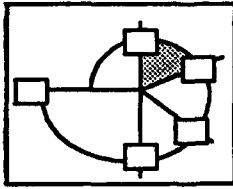


Figure 5-1. Analyze Risks and Select Strategy Activities

5.1 ANALYZE AND RESOLVE RISKS



This activity begins in Step 2, Analyze Risks and Select Strategy.

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OVERVIEW

The objective of this activity is to identify and resolve the risks associated with the identified alternatives for the process improvement program strategy and the cycle strategy. Program risks occur at the strategic level; they are analyzed in the first two cycles and then reviewed in subsequent cycles. Cycle risks occur at the tactical, or implementation, level and are analyzed in each cycle.

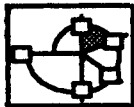
A risk is the potential for incurring undesirable results. Risk analysis is a proactive management approach that first focuses on what can go wrong and then attempts to keep it from occurring. In this activity, you will concentrate on the factors, or risks, that may prevent program or cycle success. You will specifically address these risks in this step by evaluating the strategies defined in terms of any identified constraints. The primary result of this evaluation is a quantified list of risks for the program and/or the current cycle. After identifying and quantifying risks, you will evaluate possible risk mitigation strategies and commit, plan, and execute one of those strategies.

Create an electronic or paper trail (e.g., memos to a file) for this activity. Since you will screen and evaluate a range of strategies, documentation will help you, at a later date, justify and/or explain your reasons for your decisions. This document will be referred to as your risk management plan. Refer to Appendix F for an annotated template of a risk management plan.

The risk management plan should be regarded as an evolutionary document. You will document and mitigate as many risks as you can during this activity, but that does not preclude risks from being identified later in the cycle, especially during Step 3, Plan Improvements, and Step 4, Implement Improvements.

Process Engineering With the Evolutionary Spiral Process Model (Software Productivity Consortium 1993b) provides detailed information on performing risk analysis and was the primary source for guidance for this activity. Additional guidance for supporting risk analysis can be found in Charette (1989) and the U.S. Air Force (1988).

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START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:

- Defined and approved objectives and constraints for the process improvement program and the cycle that all stakeholders support
 - Alternative program and/or cycle strategies that need to be analyzed
 - Any previous risk management plans, from either a process improvement or another organizational initiative
 - Any historical process improvement data
-

TASKS

In this activity, you will identify, analyze, and evaluate risks to your program and current cycle objectives and conduct a review of these results with the stakeholders. Then you will plan and execute risk mitigation strategies.



1. Identify and Analyze Risks. Identify all risks to your current objectives, defined in the previous step, and understand the relationship between the risks to your objectives and the alternatives you defined.

For each risk you identify, estimate the following:

- **Probability of Occurrence.** The probability of the event (risk) occurring. If there is no chance, then the event is not a risk.
- **Cost of Occurrence.** The unfavorable outcome (consequences) if the event (risk) were to occur. The outcome must have a direct impact on your objectives. If there is no gain or loss, then the event is not a risk.
- **Frequency of Occurrence.** The rate at which the event could occur over time. If the cost and probability of occurrence are constant, then the frequency of occurrence affects the amount of risk exposure. For example, an activity that is performed incorrectly once a week has an impact different from that of an activity that is performed incorrectly once a year.
- **Other Choices That Exist.** The existence of other options. If no choices exist, then the outcome cannot be prevented, and the event must be viewed as a constraint.



Sponsor



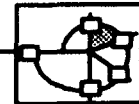
Champion



Process
User



Change
Agent



Cycle 1 In the first cycle, you look at the risks associated with the alternative process improvement strategies. Examine your program strategies in light of the objectives and constraints that you identified in Step 1, Understand Context. Look for potential inconsistencies or conflicts, and estimate the potential consequences (loss or gain) and the likelihood of each occurring. Document these risks in your draft risk management plan.

The common barriers (risks) to a process improvement program are described in the Software Engineering Process Group Workshop Survey conducted by Implementation Management Associates, SEI, and Masters Systems (1992):

- ***Pressure to Meet Schedules.*** During chaotic times, management often has neither the discipline to adhere to a process nor the interest to initiate process improvement in the organization. The organization is faced with the “chicken and egg” problem: Management and staff want to improve the process, but cannot get away from schedule pressures long enough to improve the process.
- ***Misplaced or Inappropriate Rewards.*** Historically, software engineers are rewarded for “fire-fighting” activities. Improving the process focuses on establishing “fire-prevention” activities so that there are fewer fires to put out later. In most organizations, though, the reward and recognition systems are not aligned to motivate the desired behavior, i.e., fire prevention.
- ***Lack of Commitment of Middle Managers.*** Middle management may be uncommitted to process improvement for several reasons: They are unaware of the importance of process improvement to their management (authorizing sponsor); they and their staff do not directly report to the authorizing sponsor; or they are not convinced of the need for process improvement.
- ***Lack of Key Resources.*** This barrier is similar to schedule pressure in that management is committed to process improvement, but does not have enough resources (people, money, or time) to follow through. It is best for management both to understand the level of resources required before committing to process improvement and to schedule those resources into the plan. Too often, process improvement activities are left out of planning and scheduling activities.
- ***Lack of Clear Expectations.*** Most stakeholders typically do not have a good understanding of what management expects of them and of the implications of process improvement. Without clear expectations, they are free to believe whatever they perceive to be the expectations—which are usually negative.



- **Other Major Changes.** Major changes cause organizational stress and can affect an organization's ability to handle yet another major change, such as process improvement.

Process improvement program failure incurs both short- and long-term costs. The costs associated with this risk of failure, adapted from Implementation Management Associates (1992), include:

- **Short-Term Costs.** You directly impact the organization by wasting resources (money, time, and people) and failing to achieve a stated business objective. Indirectly, the morale of your staff suffers because they may have invested their own time and energy into the process improvement program.
- **Long-Term Costs.** A direct consequence of failure of a process improvement program is that the organization's long-term strategies are not accomplished. Indirectly, the staff may have reduced confidence in management's leadership ability and may increase their resistance to the next change, thereby making it more difficult to achieve success with the next change.

Cycle 2

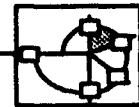
In this cycle, look at the risks associated with the alternative process assessment methods and risks associated with organizational issues, such as readiness, culture, and stress. Document these risks in your draft risk management plan.

Potential organizational risks that may be present in this cycle include the following are:

- Commitment has not been cascaded from the authorizing sponsor through all reinforcing sponsors.
- The organization's reward system is not aligned with the behaviors needed to get to the desired state.
- Rewards to the change agents for successful process improvements are unclear.
- Process users do not feel a sense of urgency for process improvement, or the desired state is not compelling enough for them to make the required changes.
- The experiences and skills of the PG members may be inadequate or unsuitably matched to the current cycle focus.
- The SC may be ineffective as a team.

Cycle N

In subsequent cycles, you will both identify risks associated with the current cycle and review the process improvement program risks defined in earlier cycles to see if any changes are needed, based on the results of previous cycles. Document these risks in your draft risk management plan.



Examples of cycle risks you may encounter include the following:

- The experiences and skills of the PG and PAT members may be either inadequate or unsuitably matched to the current cycle focus.
- Based on progress made in previous cycles, you might find that implementation and institutionalization are not moving quickly enough to enable the organization to see benefits. It is very hard for management to continue to support improvement efforts without seeing any progress made. Try to mitigate this risk by planning short-term activities (incremental progress) into the cycle, if possible.
- Based on progress made in previous cycles, you might find that the improvements are not making the expected impact. You might mitigate this risk by looking at your cycle objectives to see if you are focusing on the proper areas.



2. Review Risk Analysis. This task provides an opportunity for team review and comment on the risk identification and analysis results. This review also provides an opportunity for additional risks to be identified. It may be necessary to repeat the previous task until consensus occurs on the identification and analysis of risks.

Cycle 1...N



Have all stakeholders for this cycle review the draft risk management plan that includes these results. Incorporate their comments as needed.

3. Evaluate and Plan Risk Mitigation. During this task you both identify strategies to reduce the cost and/or probability of risk occurrence to an acceptable level, and document the estimated cost and schedule for each risk mitigation strategy. Risk mitigation strategies generally fall into one or more of the following categories:

- **Risk Reduction.** Reduce either the likelihood of a risk occurring and/or the magnitude of the risk. For example, the risk of a late delivery may be reduced by extending the schedule.
- **Risk Protection.** Lessen the impact of a risk. Insurance is an example of risk protection.
- **Risk Transfer.** Reallocate risks to areas better able to handle them.
- **Risk Contingency Fund.** Establishes a reserve of resources that is set aside to compensate for any unplanned situations. The most common reserved resources are time and money.
- **Risk Acceptance.** Accept the consequences when there may be no cost-effective means to avert a risk.

\$ Sponsor



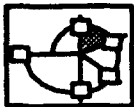
Champion



Process User



Change Agent



It is possible for risk mitigation strategies to introduce new risks that detract from the anticipated benefits. For example, extending a schedule to reduce a delivery date risk may introduce a risk of contract noncompliance. Therefore, the impact of the risk mitigation strategies must also be identified, analyzed, and evaluated.

For each of the alternate strategies, answer the following questions:

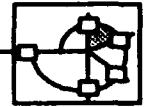
- What does the strategy entail?
- Is the strategy feasible?
- Does the strategy seem effective to reduce risk to an acceptable level?
- Will the strategy negatively impact another risk or objective?
- What is the potential impact of new risks, if any, introduced by the strategy?
- Does the strategy support cycle objectives?
- Are the tactics and means for implementing the strategy consistent with cycle constraints?
- Is the strategy cost-effective, or will it use more resources than can reasonably be expected to be saved through the risk mitigation?

Cycle 1...N

Document the risk mitigation strategies in your draft risk management plan. This plan is enhanced later in the cycle. For each mitigation strategy, include:

- Description of the mitigation strategy
- Specific risk(s) that you will mitigate
- Work breakdown structure (WBS) that lists the individual tasks that you need to accomplish, including an estimate of how long it will take to complete each task, when the task is to begin, and an estimate of the resources required
- Any constraints that may affect this mitigation strategy
- Criteria for success (i.e., when you will consider the risk[s] to be mitigated)

Refer to Appendix F for an annotated template of a risk management plan.



4. Commit to the Risk Management Plan. This task is a mechanism for formally briefing all stakeholders on the contents of the draft risk management plan and the risk mitigation strategies.

Cycle 1...N

Obtain consensus and commitment from the stakeholders for this cycle to the risk mitigation strategies. If consensus is not reached or commitment not secured, then the risk activities in Step 2 may need to be repeated.



5. Execute Risk Management Plan. In this task, you execute the risk mitigation activities outlined in the draft risk management plan, developed in the previous task. Depending on the risk mitigation activities, you may need to involve all stakeholders.

Cycle 1...N

Perform the risk mitigation activities as outlined in the risk management plan. For each risk mitigation activity, you may want to either complete one or more cycles, or spin off another spiral.

.....

MEASURES

In order to quantify resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:

- Time and effort spent identifying and analyzing risks
- Number of risks identified and analyzed
- Time and effort spent reviewing risk analysis
- Number of persons involved in reviewing risk analysis
- Time and effort spent evaluating and planning risk mitigation strategies
- Number of risk mitigation strategies
- Time and effort spent executing risk mitigation strategies
- Number of persons involved in executing risk mitigation strategies
- Time and effort spent developing the risk management plan
- Size of the risk management plan (e.g., number of pages)
- Quality of the risk management plan

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\$ Sponsor



Champion



Process
User



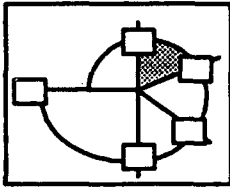
Change
Agent



STOP CRITERIA

This activity is complete when you have identified, analyzed, and mitigated any risks related to the alternative process improvement strategies and the alternative cycle strategies.

5.2 SELECT IMPROVEMENT STRATEGY



This activity begins in Step 2, Analyze Risks and Select Strategy.

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OVERVIEW

The objective of this activity is to select one of the alternative strategies identified in Step 1, based on your program and cycle objectives and constraints, your understanding of the process to be improved, and on your analysis of the risks associated with each of the identified alternatives.

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START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:

- Defined and approved objectives and constraints for the software process improvement program and the cycle that are supported by all stakeholders
 - Alternative program and/or cycle strategies
 - Results from executing the risk management plan, including risk mitigation
-

TASKS

You will select the recommended program and/or cycle strategy.



1. Select a Process Improvement Program and/or Cycle Strategy. Based on your approved objectives and constraints for the program and cycle, the alternative strategies identified, and the risk analysis and mitigation conducted in the previous activity, you select a recommended strategy for the process improvement program and the cycle. You also generate documentation as to why you selected one strategy over the others.

Cycle 1,2

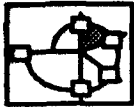
For these two cycles, review the process improvement program strategies and results of any risk mitigation with other champions and change agents

\$ Sponsor

 Champion

 Process User

 Change Agent



who are assisting you with program initiation. Select a strategy for the process improvement program. This strategy may be modified in Cycle 2 to incorporate comments from the stakeholders (e.g., management may not support and sponsor the program without certain changes made to the strategy).

Cycle N In subsequent cycles, select a strategy for the current cycle. If the program strategy has changed because of progress made in previous cycles, or different alternative program strategies have been identified and analyzed, then you may need to select a new program strategy.

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MEASURES

In order to quantify resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:

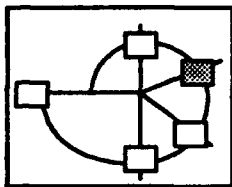
- Time and effort spent reviewing the program/cycle strategy
- Number of persons involved in reviewing the program/cycle strategy
- Time and effort spent selecting the program/cycle strategy
- Time and effort spent changing the program/cycle strategy

.....

STOP CRITERIA

This activity is complete when you have arrived at the recommended process improvement program and/or cycle strategy, and have prepared documentation as to why this strategy is recommended over the others.

5.3 COMMIT TO STRATEGY



This activity begins in Step 2, Analyze Risks and Select Strategy.

.....

OVERVIEW

Your objective in this activity is to seek commitment from all stakeholders to the strategy for the process improvement program and/or the cycle. A key part of this activity is for the sponsors to publicize the recommendation and commitment throughout the organization. Ample opportunity should be provided for the stakeholders to review and comment on your recommendations. Based on the review results, you may determine that you need to revise your recommendations.

.....

START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:

- Recommended strategy for the process improvement program and/or the cycle, along with documentation to support this selection
 - Understanding of who are the stakeholders for this activity
-

TASKS

You need to obtain approval from the identified stakeholders on the selected program and/or cycle strategy.



1. Obtain Agreement From Change Agents, Champions, and Process Users. Seek agreement first from identified stakeholders other than the sponsors. The sponsors will approve your selection with less resistance when there is buy-in from the other players involved. Since the champions and change agents helped identify the selected strategies, focus on getting the process users and any other champions and change agents to review and agree on the selection. You may need to go through several iterations of the review process before an agreement is reached.

\$ Sponsor



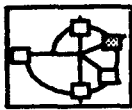
Champion



Process
User



Change
Agent



Cycle 1 You will seek agreement on the process improvement program strategy in the first cycle. While it is better to have strong support early on, remember that some stakeholders resist change, especially when there is no sponsor. Do not get hung up in trying to get everyone's full agreement. Identify those stakeholders who do agree; they can become champions later in the process. Pay attention to the grumbling you hear; the causes may become barriers (risks) in Cycle 2.

Cycle 2 Again, you will seek agreement on the process improvement program strategy, though you may modify the program strategy based on any recommended changes.

Cycle N In later cycles, you will seek agreement on the cycle strategy, which is how the organization will implement improvements based on assessment recommendations.



2. Obtain Approval From Sponsors. After you have buy-in from champions, change agents, and process users, present your recommendations to the sponsors for approval. Your presentation should include:

- Description of the recommendation
- Your rationale for the recommendation
- Anticipated impact of the recommendation on the organization, especially the impact on each sponsor's group
- Estimated cost and time frame for the recommendation

Depending on your situation, you may decide to stagger the presentations, targeting first those sponsors who are more supportive, in order to build a stronger case for those sponsors who are less supportive.

You may have to go through several iterations of your presentation to management before you get a final decision to go ahead with the implementation. If so, return as necessary to any task in this activity or in the Analyze and Resolve Risks or Select Improvement Strategy activities in order to secure the decision to proceed.

Cycle 1 This task is not performed until adequate sponsorship is established.

Cycle 2...N In later cycles, you will seek approval on the process improvement program strategy and the cycle strategy.



3. Publicize Commitment. After approving the recommendation, the sponsors need to publicize their support and commitment throughout their organizations to keep everybody informed, to reinforce the importance of process improvement, and to help prepare everybody for the changes ahead.

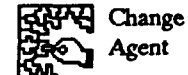
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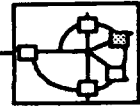
Champion



Process User



Change Agent



- Cycle 1* This task is not performed until adequate sponsorship is established.
- Cycle 2...N* Assist the sponsors with developing a communication strategy to publicize commitment. Use the influence strategy created in Step 1, Understand Context.
-

MEASURES

In order to quantify resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:

- Time and effort spent reviewing the program and cycle strategies with change agents, champions, and process users
 - Number of persons interacted with during the review
 - Time and effort spent developing a management presentation
 - Size of the management presentation (e.g., number of charts)
 - Quality of the management presentation
 - Time and effort spent meeting with sponsors
 - Number of presentations to and meetings held with sponsors
 - Time and effort spent publicizing commitment
 - Number of persons to whom and places where commitment was publicized
-

STOP CRITERIA

This activity is complete when:

- You have secured commitment from all stakeholders on the program and/or cycle strategy
- The sponsors have publicized their commitment to software process improvement to the organization

6. CHART A COURSE: PLAN IMPROVEMENTS

Focus on the vital few, not the trivial many.

The Pareto Principle

Section Objectives

1. Provide guidance for planning process improvement activities

2. Provide guidance for obtaining commitment to the plan

Commitment to and implementation of process improvements cannot occur without a well-thought-out and documented plan. This section provides guidance for the activities shown in Figure 6-1.

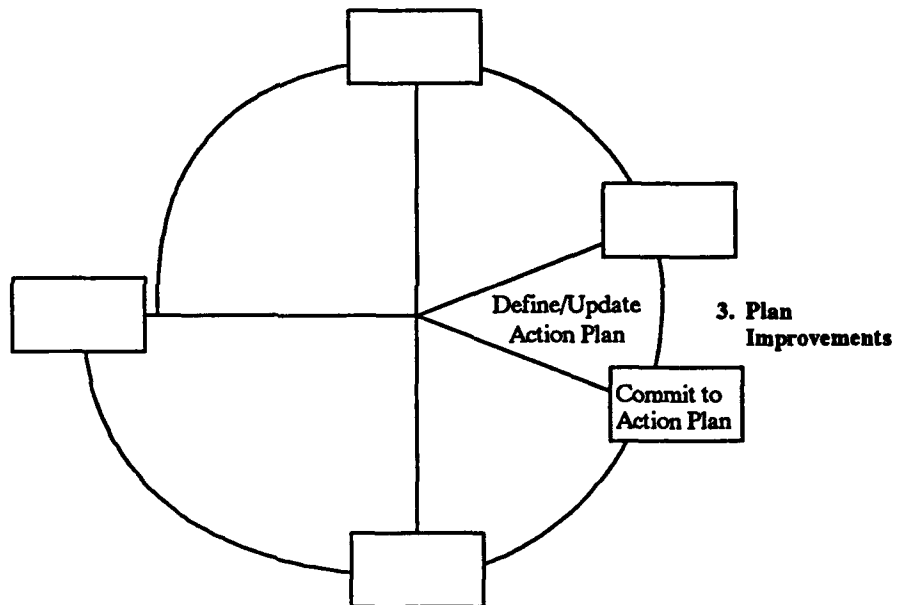
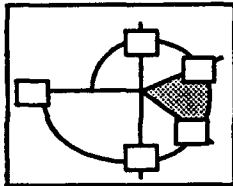


Figure 6-1. Plan Improvements Activities

6.1 DEFINE/UPDATE ACTION PLAN



This activity begins in Step 3, Plan Improvements.

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OVERVIEW

Your objective in this activity is to develop an action plan detailing the implementation of the chosen strategy. The plan is based on the cycle objectives, constraints, and strategy defined and approved in the previous steps of this cycle. The sponsor is more apt to provide and sustain commitment when the implementation details are well understood.

The action plan activity should begin within four to six weeks after completion of the Step 1, Understand Context, activities and may be performed concurrently with Step 2, Analyze Risks and Select Strategy. A final draft of the action plan should be released within four to six weeks after commencing this activity. The longer it takes either to commence planning or to release a draft, the greater the chance of losing momentum and sponsorship.

This is a good opportunity for you to increase involvement of other stakeholders. Increased involvement has several beneficial effects; the most notable is surfacing resistance. Other effects are decreased stress and greater commitment to process improvement. By involving stakeholders with the planning activity, you demonstrate to them that process improvement is not being done to them, but with them.

The action plan should be regarded as an evolutionary document. Do not delay its release while searching for perfection! As you gain additional information and insights, you will update the action plan.

The action plan is derived from a broad collaboration of all stakeholders involved in process improvement. It covers the following:

- Underlying motivation for the process improvement program
- Overall strategy of the organization for the process improvement program
- Major areas that will be addressed in this cycle
- Procedures for planning improvement activities for specific projects in each major area of improvement



- Groups responsible for taking action in each major area, the resources needed, and a schedule

The action plan is typically a set of plans and guidelines; the physical structure is up to you. Figure 6-2 illustrates a logical action plan structure (Fowler and Rifkin 1990).

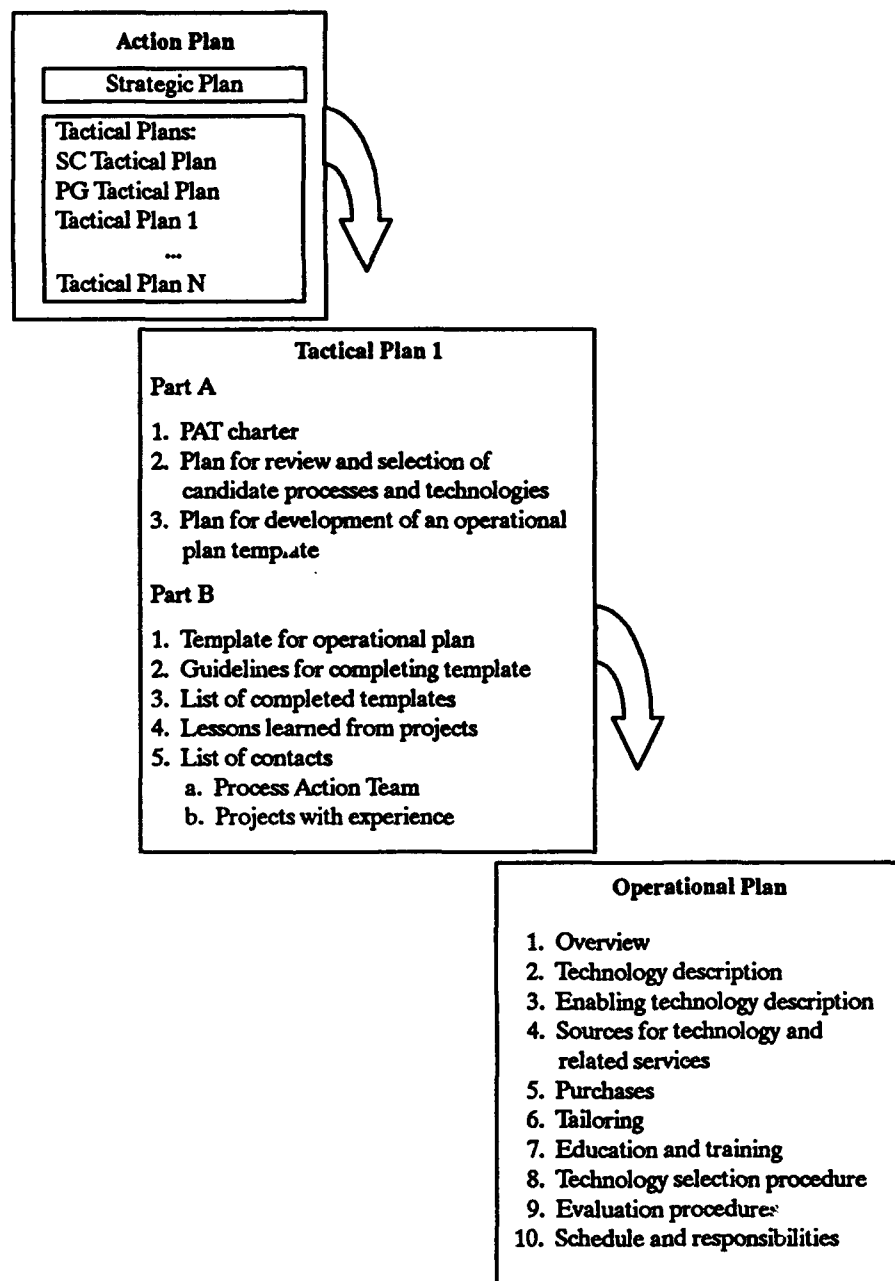
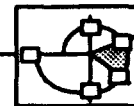


Figure 6-2. Example Action Plan Structure

- **Strategic Plan.** The strategic plan is based on the findings from an assessment, and addresses the motivation and direction of the organization's process improvement program, including charters for



both the SC and PG. Typically, the SC is responsible for developing the strategic plan.

- **Tactical Plan.** The tactical plans describe the work to be done in the current cycle by the SC, the PG, and the PATs. The plan for each PAT includes a charter for the group, describes the direction of work, and includes both a detailed plan for improving a particular process area and a plan for developing an operational template for applying the process. Once the PAT has made improvements to a process and developed an operational plan template, the PAT transfers the process to one or more projects. The information gathered during this transfer is rolled back into the tactical plan for future use.
- **Operational Plan.** The operational plans are developed by a PAT for a particular project that is focused on improving a particular area. The plan details the activities performed to transfer a particular technology from a PAT to a project. For a complete description of and guidance for technology transfer, refer to *Using New Technologies: A Technology Transfer Guidebook* (Software Productivity Consortium 1993e).

A template for an action plan can be found in Appendix G.

START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:

- Approved objectives, constraints, and strategy for the cycle
- Results from an assessment, or information and/or knowledge gained from an informal appraisal
- Plans from any previous process improvement efforts

TASKS

You will manage the development of each part of the action plan and assemble them together to finalize the action plan.



1. **Establish a PAT for Each Major Area of Improvement.** Based on the strategy selected in Step 2, either a PAT or the PG ultimately is responsible for developing improvements in a particular technical area and for applying them to one or more projects.

\$ Sponsor



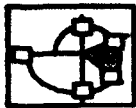
Champion



Process
User



Change
Agent



A PAT is comprised of experienced professionals with strong backgrounds and interests in the technical area under improvement. Each project that is affected by the technical area should have a representative on the PAT.

Guidelines for selecting the PAT leader are:

- Senior engineer with experience in the technical area being addressed
- Advocate of process improvement
- Software Process Assessment (SPA) participant—ideally as an assessment team member
- Project management skills
- Strong team building and team dynamics skills

Generally, the PAT leader is a member of the PG during the life span of the PAT. It is the responsibility of the PAT leader to coordinate and manage the team's activities and to report progress to the PG and the SC.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N If a PAT is to address a major area of improvement, identify potential team members, including a PAT leader.

After the team has been established, work on building a strong, dynamic team to increase its effectiveness. This group will work closely with project staff to implement process improvement. If the team is perceived as ineffective or dysfunctional, the process improvement program will not be perceived positively.

\$



2. Task Each PAT to Develop a Tactical Plan. You are now at the point where plans to improve specific areas in your process are developed.

The primary responsibility of the PAT (which may be the PG) is to develop a tactical plan to improve a specific technical area. This plan covers all the activities that the PAT performs, estimates of schedules and resources, and other relevant information, such as potential risks. The PAT typically plans for the following activities:

- Understanding the existing process (sometimes called the “as-is”) well enough to establish requirements of the process
- Documenting the new process (sometimes called the “to-be”)
- Refer to the *Process Definition and Modeling Guidebook* (Software Productivity Consortium 1992a) for more information

\$ Sponsor



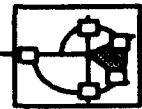
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Process
User



Change
Agent



- Examining industry best practices by, for example, attending conferences/workshops, reading conference papers, or participating in outside working groups
- Screening new technologies
- Making recommendations on new technologies to pilot
- Planning, in coordination with the PG, for technology transition
- Organizing workshops/seminars to disseminate new technology information
- Working with the PG to design operational plans for projects
- Assisting with execution and evaluation of these projects
- Preparing templates for the operational plans, along with guidelines and examples

Though the plan comes from the PAT as a team, the PAT leader may be the only one working on the first draft of the plan. The other identified team members may be involved to a lesser extent until implementation actually begins.

Technology transfer-related activities are covered in *Using New Technologies: A Technology Transfer Guidebook* (Software Productivity Consortium 1993e.)

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Task each PAT to develop a plan to address improvements in its assigned technical area, including estimates of resources and schedules.

\$



3. Task the SC to Develop a Tactical Plan. The SC has responsibilities to perform during the implementation of process improvements and should have a plan for executing its duties.

The SC's role is to provide support for process improvement. Support comes in many forms, such as (Fowler and Rifkin 1990):

- Developing organizational policies for process activities
- Resource and process management
- Building consensus among various groups
- Interfacing with other high-level committees or corporate planning offices



Sponsor



Champion



Process
User



Change
Agent



- Developing charters for the PG and PATs
- Preparing strategic plans
- Setting priorities for actions

Another important role of the SC, due to the high organizational level of its members, is to reinforce sponsorship and commitment to process improvement throughout the organization. Emphasizing the responsibility and value of the SC will motivate middle management to become supporters of process improvement. The SC should communicate information concerning process improvement to many other areas of the organization. Communication of this information may come in many forms:

- Providing additional process improvement concept training
- Providing brown-bag lunches on process improvement
- Providing status briefings on the strategies or direction of process improvement within the organization

This information flow encourages others to initiate process improvement activities and provides visibility of your organization's process improvement success.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Ask the SC to develop a plan to address its responsibilities for this cycle, including estimates of resources and schedules.



4. Task the PG to Develop a Tactical Plan. The PG has responsibilities to perform while the PATs implement specific process improvements. Some ongoing activities of the PG are:

- Establishing and maintaining management sponsorship and commitment
- Maintaining collaborative relationships with managers and engineers
- Setting appropriate expectations for engineers and managers
- Arranging for relevant training and education
- Tracking, monitoring, and reporting the status of software process improvement efforts

\$ Sponsor



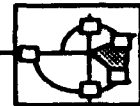
Champion



Process
User



Change
Agent



- Participating in organizational improvement initiatives
- Participating in organizational planning

In addition to these program management activities, the PG is responsible for performing technical activities, such as:

- Defining and maintaining an organizational process architecture, in collaboration with managers and engineers
- Working with each PAT to ensure that all processes integrate into the organization's process architecture
- Maintaining a process database
- Providing process consultation to development projects and management

Refer to *Process Engineering With the Evolutionary Spiral Process Model* (Software Productivity Consortium 1993b) for additional details on engineering your organization's processes.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Task the PG to develop a plan to address its responsibilities for this cycle, including estimates of resources and schedules.



5. Incorporate Each Tactical Plan Into the Action Plan. The tactical plans and the strategic plan need to be assembled into an action plan. Any conflicts among the individual plans and with the organizational objectives and constraints need to be addressed.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Gather the tactical plans from each PAT, the PG, and the SC, and incorporate them into an action plan.



6. Identify Budget and Staffing. You need to identify the expected budget and staffing requirements for this cycle, based on the resource estimates provided by each group (i.e., the SC, the PG, and each PAT).

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Study the estimates of resources and schedules from each tactical plan so that you can develop an overall budget and the staffing requirements to achieve the objectives of this cycle. Specifically, you need to do the following:

- Identify needed internal and external resources, including trainers and consultants, to assist you in areas with low levels of expertise.

\$ Sponsor



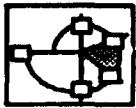
Champion



Process User



Change Agent



- Identify and record the expected costs of the improvements made in this cycle. Specifically, you need to understand the costs for training (both to develop training materials and to provide the training), increased support requirements, integration time and costs, and initial productivity loss due to the learning curve. Refer to Head (1985) for guidance on training cost analysis.
- Allocate time and resource contingencies to address such problems as emerging resistance to improvements, waning sponsorship and commitment, and interference by other seemingly independent changes.



7. Develop Measures of Success. Define the success criteria for the current cycle, and define when in the cycle's implementation you will assess progress against these success criteria.

Cycle 1,2

This task is not performed until adequate sponsorship is established.

Cycle N

Guidance for defining the success criteria and data collection requirements are given below. Refer to Appendix H for more information regarding process and product measures, and a method to help you define measures based on your goals.

Success Criteria. The cycle's success criteria are the measures against which you will determine when the implementation has reached such a state that you should do a full-scale review and update of plans as described in Step 5. Your success criteria must:

- Support both the cycle and software process improvement program objectives and strategies
- Define when the implementation will be complete for this cycle
- Ensure progress against the overall program objectives

Data Collection Requirements. The cycle's data collection requirements are used both to assess empirically the impacts of the improvements on the process and process users, and to determine progress against the success criteria defined for the cycle. Your data collection requirements must:

- Be tied directly to this cycle's success criteria
- Include specifications of what data will be collected by whom and from whom
- Ensure that data collected includes data received from talking to and surveying process users to determine their level of satisfaction with the new processes

\$ Sponsor



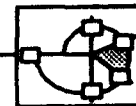
Champion



Process
User



Change
Agent



- Identify the specific times during the cycle's implementation period ("snapshots") when implementation should be assessed against the success criteria.
- Specify how the level of process improvements will be measured. For example, if project planning policies and procedures do not exist in your organization, then you may not want to have as success measure the degree of institutionalization. A more realistic measure may be to have all policies and procedures documented and all personnel trained.



8. Analyze Risks Associated With the Action Plan. Now that you have a greater understanding of the implementation details, you may identify new risks to achieving your program and/or cycle objectives. For example, after identifying the budget and staffing requirements, you may determine that you do not have an adequate staffing level to achieve your objectives. To mitigate this risk, you could either rescope your cycle objectives and re-plan the activities, or talk to your sponsor about committing more resources. Refer to the activity Analyze and Resolve Risks in Step 2 for more guidance on risk analysis. You may choose to spin off a spiral to handle either of these cases.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Document any additional risks that have been identified because of your greater understanding of the tactical plans. Evaluate, plan, and execute risk mitigation strategies. Update the risk management plan to reflect the new risks and mitigation strategies.



9. Finalize the Action Plan. You need to prepare a formal plan that covers what needs to be done to improve the organization's process in this cycle. A final draft should be released within four to six weeks of commencing this activity.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Document in the action plan all the information you have gathered in this activity and prepare the plan for release to your sponsor.

.....

MEASURES

In order to quantify the resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:

\$ Sponsor

 Champion

 Process User

 Change Agent



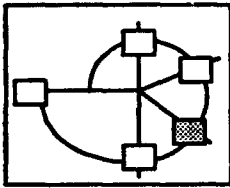
- Time and effort spent developing the strategic and tactical plans (by SC, PG, and PATs)
- Size of the strategic and tactical plans (e.g., number of pages)
- Quality of the strategic and tactical plans
- Time and effort spent incorporating tactical plans into the action plan
- Number of action items
- Number of recommendations addressed in the action plan, not addressed in the action plan, and items not found in the recommendations
- Number of items addressed in the action plan that are not found in the recommendations
- Time and effort spent identifying budget and staff requirements
- Time and effort spent developing measures of success
- Time and effort spent finalizing the action plan
- Size of the action plan (e.g., number of pages)
- Quality of the action plan
- Planned size and budget of the PG
- Planned number, size, and budget for the PATs
- Number of risks identified, analyzed, and mitigated
- Time and effort spent identifying and resolving risks
- Time and effort spent updating the risk management plan

.....

STOP CRITERIA

This activity is complete when you have developed an action plan that details what needs to be done, including the formation of PATs, if needed, to improve the organization's process during this cycle.

6.2 COMMIT TO ACTION PLAN



This activity begins in Step 3, Plan Improvements.

OVERVIEW

Your objective in this activity is to get all stakeholders—including sponsors, champions, change agents, and process users—to commit to the action plan for this cycle. A key part of this activity is for the sponsors to publicize the commitment across the organization. Ample opportunity should be provided for the stakeholders to review and comment on the plan. Based on the review results, you may determine that you need to revise the plan.

START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:

- Approved cycle strategy, objectives, and constraints
- Detailed action plan for the cycle
- Understanding of who are the stakeholders for this commitment

TASKS

You need to obtain approval from the identified stakeholders on the action plan and commitment to proceed.



1. Obtain Agreement From Change Agents, Champions, and Process Users. Seek approval first from all identified stakeholders other than the sponsors. The sponsors may be reluctant to approve the plan until there is buy-in from all the other players involved.

Cycle 1,2

This task is not performed until adequate sponsorship is established.

\$ Sponsor



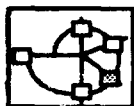
Champion



Process User



Change Agent

*Cycle N*

You need to get the identified champions, change agents, and process users to review and approve the plan. You may need to go through several iterations in the review process before they will approve it.

\$



2. Obtain Commitment From Sponsors. After you have buy-in from the identified champions, change agents, and process users, present your plan to the identified sponsors for approval. Your presentation should include:

- Description of the plan
- How the plan supports the cycle objectives and makes progress against the overall process improvement objectives
- How this plan is likely to affect each part of the organization for this cycle, especially the groups related to the sponsors you are briefing
- Estimated cost and time frame for the implementation of this plan

Depending on your situation, you may decide to stagger the presentations, targeting first those sponsors who are more supportive, in order to build a stronger case for those sponsors who are less supportive.

You may go through several iterations of your presentation to management before you get a final decision to go ahead with the implementation. If so, return as necessary to any task in this activity or in the Define/Update Action Plan activity to secure the decision to proceed.

Cycle 1,2

This task is not performed until adequate sponsorship is established.

Cycle N

You will seek commitment from the authorizing and reinforcing sponsors.

\$



3. Publicize the Commitment. After approving the action plan, the sponsors need to publicize their support and commitment throughout their organization to keep everybody informed, to reinforce the importance of process improvement, and to help prepare everybody for the changes ahead.

Cycle 1,2

This task is not performed until adequate sponsorship is established.

Cycle N

Assist the sponsors with developing a communication strategy to publicize commitment. Use the influence strategy created in Step 1, Understand Context.

.....

MEASURES

In order to quantify the resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:

\$ Sponsor



Champion

Process
UserChange
Agent



- Time and effort spent reviewing the action plan with change agents, champions, and process users
- Number of persons interacted with during the review
- Time and effort spent developing a management presentation
- Size of the management presentation (e.g., number of charts)
- Quality of the management presentation
- Time and effort spent meeting with sponsors
- Number of presentations to and meetings held with sponsors
- Time and effort spent publicizing commitment
- Number of persons to whom and places where commitment was publicized

.....

STOP CRITERIA

This activity is complete when:

- You have secured commitment from all identified stakeholders on the action plan
- The sponsors have publicized their commitment on the action plan

7. JUST DO IT: IMPLEMENT IMPROVEMENTS

While the dust is still on your feet, sell what you have brought to the market.

Babylonian Talmud, Pesahim

Section Objective

Provide guidance for implementing and managing process improvements

Once the action plan is approved, implementation does not happen just by turning on a switch. The action plan must be implemented by the PG, PATs, and process users, managed by the PG and SC, and supported by the sponsors and champions. This section provides guidance for the activities shown in Figure 7-1.

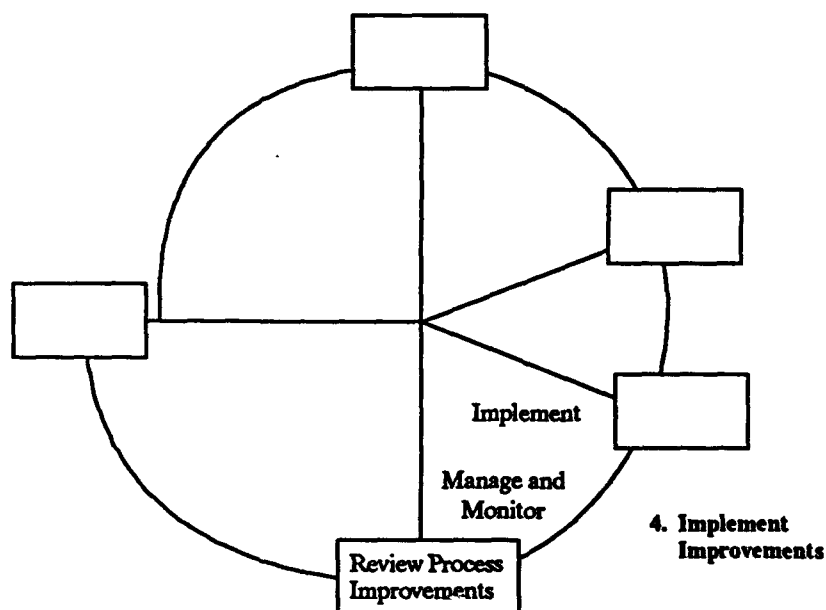
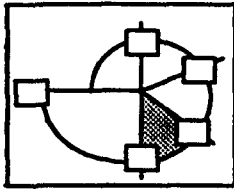


Figure 7-1. Implement Improvements Activities

7.1 IMPLEMENT



This activity begins in Step 4, Implement Improvements.

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OVERVIEW

Your objective is to carry out the action plan for this cycle. Each group—the PG, the SC, and each PAT—will implement the work described in the detailed tactical plan they developed in the previous step. This activity should be performed with the same urgency as you would a software development project for an external client. This activity is performed in parallel with the Manage and Monitor activity.

The majority of the work that occurs in this activity is detailed in the individual tactical plans and performed by the assigned PATs. To implement process improvements in technical areas, the PATs should follow the post-planning guidance (Cycle N) as described in *Using New Technologies: A Technology Transfer Guidebook* (Software Productivity Consortium 1993e).

While the PATs address improvements in specific technical areas on specific software projects, the PG and SC should focus on performing the work described in their respective plans. Figure 7-2 depicts the relationship and interactions among these three groups and the projects (Fowler and Rifkin 1990).

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START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:

- Approved, detailed action plan, including tactical plans for each PAT, the SC, and the PG
 - Resources to perform the improvements
-

TASKS

You will implement the work described in each tactical plan developed in the previous step.

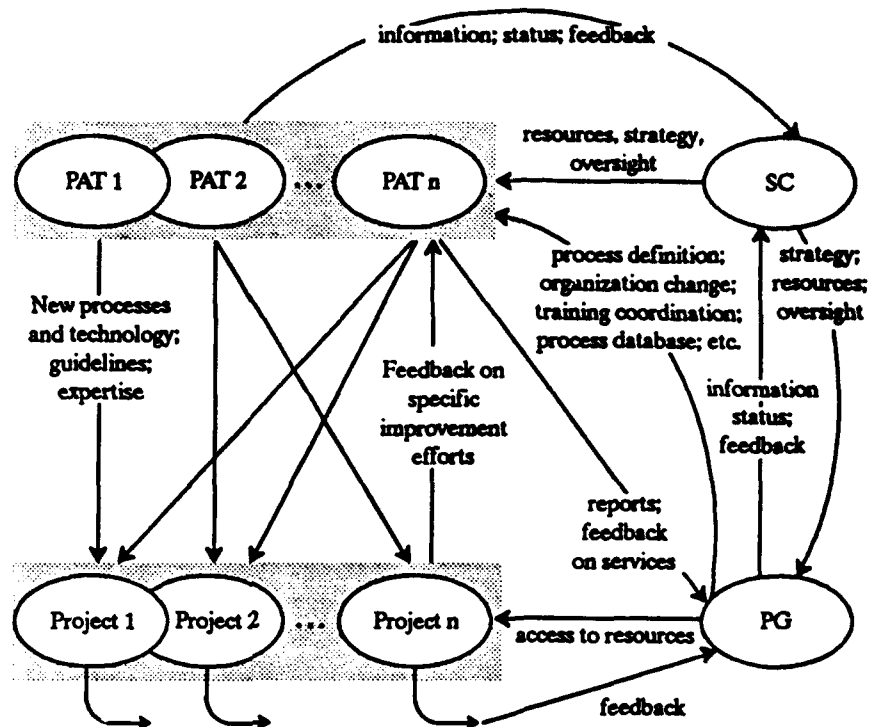
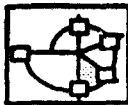


Figure 7-2. Infrastructure Interactions



1. Implement the Action Plan. The action plan is comprised of a set of tactical plans, one for the SC, one for the PG, and one for each PAT established. Each group carries out the actions specified in its respective tactical plan.

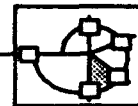
Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N This task may be accomplished by having each group spin off a spiral to address its specific responsibilities. This approach provides a means for each group to address risks to its objectives and evolve its plans. Each group is responsible for updating its respective plans, based on lessons learned. Changes in the plans are communicated to the PG.

MEASURES

In order to quantify the resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:





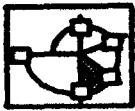
- Size and budget of the PG
- Number, size, and budget for the PATs
- Time and effort spent implementing the action plan

To get accurate information on this measure, it is best for each group to record the time and effort spent implementing its respective tactical plan. If the groups are using the spiral process to manage their activities, the measures would be similar to those listed with each activity in this guidebook.

- Causes for delayed implementation
- Time and effort spent updating the action plan
- Causes for updating the action plan
- Number of activities updated, either new or revised
- Size of the updated action plan (e.g., number of pages)
- Number of times the action plan is updated
- Volatility of the action plan changes (i.e., number of critical path changes)
- Number of projects using the new or revised process
- Number of persons using the new or revised process
- Improvements in processes and products in the projects using the new processes

Each PAT develops an operational plan describing how a project will use the new processes or technologies. Included in this operational plan is a list of measures that the project will collect to quantify the effects of process improvement. Appendix H provides an overview of software product and process measurement.

- Quality of the new or revised process
- Process user satisfaction ratings
- Number of training days for the PG, the PATs, and the process users by training type (e.g., team dynamics training versus specific process training)



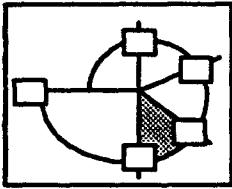
These measures should not be collected just once, but at regular intervals over the course of implementation. This provides trend information that you can monitor as the implementation progresses.

.....

STOP CRITERIA

This activity is complete when you have completed the implementation as defined in the action plan for this cycle, including all tactical plans.

7.2 MANAGE AND MONITOR



This activity begins in Step 4, Implement Improvements.

.....

OVERVIEW

Your objective in this activity is to manage the implementation of process improvements and to collect data to be used in later review activities. This activity should be performed in the same manner as a software development project for an external client. In fact, it is useful to adopt analogous structures and processes (e.g., schedule monitoring, status meetings, and reports).

There are crucial differences between working on a such a project, however, and implementing process improvements. Inevitably, as the process unfolds, there will be resistance and fear—the by-products of major change. These issues need to be addressed by bringing them out in the open and addressing them the best way you can. Refer to Section 2.2, Human Responses to Change Are Complex.

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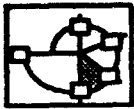
START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:

- Approved action plan, including all tactical plans
 - Resources to manage and monitor the implementation
-

TASKS

The primary task in this activity is managing the implementation of the action plan for this cycle. The other tasks are listed here as separate tasks to emphasize their key role in the success of process improvement: addressing resistance to change and supporting the PATs. This activity is performed in parallel with the Implement activity.



\$



1. Manage the Implementation. Implementation of the tactical plans should demonstrate visible progress toward the objectives of the cycle and the process improvement program. If the implementation is not managed, visibility becomes almost impossible.

Cycle 1,2

This task is not performed until adequate sponsorship is established.

Cycle N

Manage the implementation just as you would any other software development project. Specifically, you undertake the following:

- Begin the implementation with a kickoff meeting, inviting champions, change agents, and senior management (sponsors). Review each implementation task and the overall process improvement schedule. Confirm resource (people, time, money) availability. Create enthusiasm for the process improvement cycle. The meeting should end with an agreement on when the implementation tasks should commence and when the next meeting will be held.
- Hold regular meetings during the implementation to highlight issues and problems that each PAT may face. Resolve conflicts and misunderstandings among the PATs.
- Track progress of the implementation against the schedules defined in the action plan.
- Track progress against your planned budget.
- Publicize periodically the progress of the implementation to your management, the SC, other sponsors, champions, and process users within the organization.
- Maintain communication among all stakeholders (sponsors, change agents, champions, and process users) on the status of the implementation. This will continue process improvement momentum and buy-in.



2. Gather Implementation Data. Gather data during the implementation to show progress toward your cycle objectives. This data will be used in the Review Progress activity in Step 5. The data to be collected is defined in the action plan (see Task 7, Develop Measures of Success), in the Define/Update Action Plan activity.

Cycle 1,2

This task is not performed until adequate sponsorship is established.

Cycle N

Gather and analyze information to determine if process improvements are progressing as planned. Specifically, you undertake the following:



Sponsor



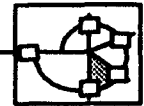
Champion



Process
User



Change
Agent



- Ensure that you are receiving progress reports from the PATs on a regular basis, as defined in each tactical plan.
- Gather additional, potentially subjective, information from the PATs and the pilot projects involved with the improvements.

Check the information you have gathered against the measures and success criteria outlined in the action plan to determine if you are progressing as expected. If the implementation achieves completion criterion, determine whether you want to continue progress with the implementation or move on to the next step, Review and Update, and formally analyze the implementation at this point. Keep the following guidance in mind when making this determination:

- Before you move to the next activity for a formal review, ensure that the implementation has been completed to such a point that it makes sense to proceed with the next step. If you stop implementation too early—before improvements have been made—you risk reporting benefits that do not accurately portray reality. If you wait too long, you risk dampening the enthusiasm for the change and/or losing management commitment by not publicizing success stories early enough.
- If you do not make the expected progress, find out what has happened. Slowed progress might be due to problems in the action plan, problems with vendor support, problems with political and management support, problems with stakeholder buy-in, unexpected or expected risks occurring, problems with defining the new process, or problems with the process's interface to the environment. Stop or slow down the implementation, determine how to resolve the problems, and replan, reformulate, or reperform the appropriate tasks to resolve the problems. Then continue the implementation.
- Ongoing implementation assessment should examine not only **quantitative** progress towards the cycle objectives, but also whether the new process fits the process users' needs and expectations in a **qualitative** sense. Is the process being used in ways that are true to the intent of those who selected and/or designed the improved process? Does the implementation maximize the process's potential?



3. Support the PATs. Once the PATs have become established, they must receive adequate support while they install and use the new processes. If they do not get adequate support, the probability of full acceptance and use of a process will decrease rapidly.

Cycle 1,2

This task is not performed until adequate sponsorship is established.

\$ Sponsor



Champion



Process
User



Change
Agent



Cycle N Provide support as defined in the action plan for this cycle. The support you provide can include:

- Training and education coordination
- Process consulting
- Expertise on implementing organizational change
- Access to technology experts, preferably permanently or temporarily transferred to the group



4. Analyze Risks Associated With Implementation. Now that you are implementing process improvements, you may identify new risks to achieving your program and/or cycle objectives. For example, a pilot project may experience team dynamics problems. Plan and execute mitigation strategies. For more guidance on risk analysis, refer to the Analyze and Resolve Risks activity in Step 2. You may choose to spin off a spiral to handle risk analysis.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Document any additional risks that have been identified. Evaluate, plan, and execute risk mitigation strategies. Update the risk management plan to reflect the new risks and mitigation strategies.



5. Manage Resistance to Change. Despite the fact that you have sought commitment and approval throughout the process, you will still encounter stakeholders who resist the change throughout the implementation. Listed here are some common forms of resistance (Block 1981):

- **Give Me More Detail.** The stakeholder wants to know everything about what is happening. No matter how much information you give, it is never enough. This typically occurs when sponsors ask for ROI data to demonstrate the value of process improvement.
- **Flood You With Detail.** The stakeholder gives you more information than you requested, focusing on minute details.
- **Silence.** The stakeholder is passive and has no particular reaction to what you are saying. When asked for feedback, the typical response is "Keep on going, I don't have any problems with what you're saying. If I do, I'll interrupt." This may be a signal of covert resistance.
- **Nonverbal Messages.** The stakeholder may be sending nonverbal messages of resistance, such as clenching fists, moving away from you,

\$ Sponsor



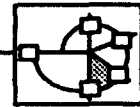
Champion



Process
User



Change
Agent



or shaking his head when you speak. Look for nonverbal behavior as a cue to resistance.

Resistance to change can be managed once it has been identified. Some ways to surface resistance are:

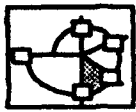
- Surveys
- Suggestion boxes
- Forums or “all-hands” meetings
- Third-party (internal or external) interviews
- Hot lines
- One-on-one discussions

For these techniques to be most effective, they need to be performed continuously, not just once. Covert resistance will not surface on the first try to expose it, but only after you have created a safe atmosphere for stakeholders.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N With your understanding of the two typical responses to change, discussed in Section 2, identify the potential resistors and their behaviors. You can best manage their resistance by doing the following:

- *Identify the cause of resistance from the stakeholder's frame of reference.* It is very important for you to understand the stakeholder's point of view. You may not agree with that view, but you should recognize that it is very important to the stakeholder.
- *Explain the change in the stakeholder's frame of reference.* The stakeholder needs to understand how process improvement will affect his or her day-to-day work and career.
- *Establish realistic expectations.* Acknowledge that there will be a feeling of uncertainty as the organization and its processes change, but that is to be expected. Describe to the stakeholders how you will manage the transition.
- *Allow the stakeholders to express their concerns.* Use techniques to surface resistance repeatedly. Ask open-ended questions, and then be quiet and listen intently.
- *Involve stakeholders in reaching your organization's objectives.* When at all possible, provide opportunities for the stakeholders to be involved in planning, process definition, and other decision-making activities.



6. Reinforce Sponsor Commitment. Most sponsors feel that their job is all downhill during the implementation of process improvements. Not so. Without maintaining the visibility and continually stressing the importance of this change, the organization is likely to slip back into its old habits. It is much easier to revert to old habits than to persevere through the change.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N During this period of transition, assist the sponsor with reinforcement by:

- Involving the stakeholders in implementing process improvements
 - Providing the resources to achieve the cycle objectives
 - Rewarding supporters of process improvement
 - Motivating stakeholders who are resistant
 - Communicating the progress of process improvement, always focusing on the desired state
-

MEASURES

In order to quantify the resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:

- Time and effort spent managing the implementation, including:
 - Project tracking and oversight
 - Updating the tactical plans
 - Progress meetings
- Number of identified risks that occurred
- Number of risks identified, analyzed, and mitigated
- Time and effort spent identifying and resolving risks
- Time and effort spent updating the risk management plan
- Number of organizational issues raised and length of time until resolution

\$ Sponsor



Champion



Process
User



Change
Agent



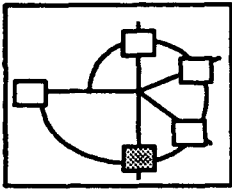
- Time and effort spent gathering implementation data
- Time and effort spent supporting the PATs and pilot projects, including training coordination, process consulting, and organizational change assistance
- Time and effort spent managing resistance to change
- Time and effort spent reinforcing sponsor commitment

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STOP CRITERIA

This activity is complete when the implementation for this cycle has been completed as defined in the action plan (set of tactical plans).

7.3 REVIEW PROCESS IMPROVEMENTS



This activity begins in Step 4, Implement Improvements.

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OVERVIEW

Your objective in this activity is to gather the process assets that were created or changed during the implementation of improvements. A process asset is any artifact that the organization considers useful in performing the activities of process definition and maintenance, such as the organization's standard software process, descriptions of software life cycles approved for use, tailoring guidelines and criteria, and any process-related documentation. The process assets will be baselined, or placed under configuration control, in the Review Progress activity in Step 5.

.....

START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:

- Approved action plan for this cycle
 - Process assets created or updated during the implementation
-

TASKS

In this activity, you collect and review the process assets defined or updated during implementation, and collect and review the lessons learned.




1. Collect and Review Process Assets. Process assets are valuable to the organization since they provide historical information that can be used for future planning activities.

\$ Sponsor

 Champion

 Process User

 Change Agent



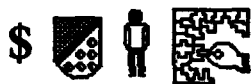
Here is an initial list of process assets that you should be concerned with:

- Action plan, including tactical plans
- Risk management plan
- Description of the improved processes from each PAT, e.g., checklist of tasks, process model, or textual description
- Data collected during the implementation that was used to assess progress against the plan
- Organization policies
- Tailoring guidelines and criteria for projects

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Gather the descriptions of the process assets that were defined or updated during this cycle. Review these assets with each PAT to ensure that they are adequately documented and understandable.

The process assets that are collected and reviewed will be baselined in Step 5, Review and Update.



2. Collect and Document Lessons Learned. The lessons learned are both strategic and tactical in nature. They focus on specific implementation issues, and should come from the stakeholders of each improved process, such as the PAT, the process users (i.e., pilot projects), managers of the pilot projects, and senior management.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Gather and document the lessons learned during the previous steps in this cycle, including organizational change issues, risk analysis, action plan development, and implementation.

These lessons learned will be shared with the organization in Step 5, Review and Update, and also baselined as a process asset.

.....

MEASURES

In order to quantify the resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:

\$ Sponsor



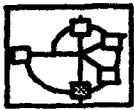
Champion



Process
User



Change
Agent



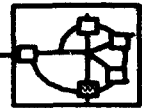
- Time and effort spent collecting and reviewing process assets
- Number of persons involved in the review
- Number of change requests, open or resolved, per process asset
- Number of process assets created or revised
- Time and effort spent collecting and documenting lessons learned
- Number of lessons learned that were collected and documented

.....

STOP CRITERIA

This activity is complete when:

- You have prepared a description of each process asset that was generated or updated during the implementation
- You have prepared a description of the lessons learned



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8. STEER TOWARD SUCCESS: REVIEW AND UPDATE

Managing in accordance with a strategic plan is a learned art. The longer you use the tool, the better you are able to manage with it.

R. Henry Miglione, *An MBO Approach to Long-Range Planning*

Section Objective

1. Provide guidance for reviewing the results of the implementation
2. Provide guidance for deciding how to proceed

Once the process improvements have been made in this cycle, you need to review the progress against the objectives in both the action plan and the process improvement program plan (strategy). Based on this review, you will update your plans and strategy, define recommendations for proceeding, and, if you receive commitment, continue with another cycle of process improvements. This section provides guidance for the activities shown in Figure 8-1.

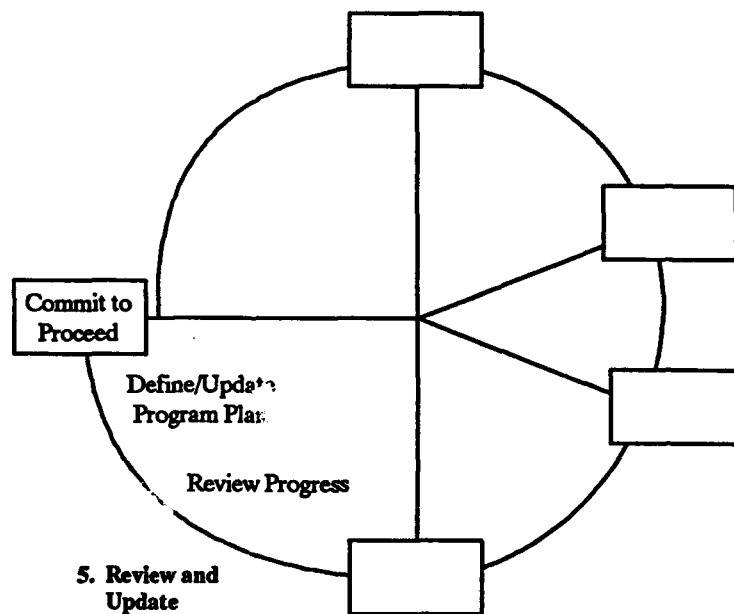
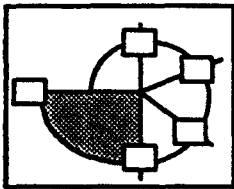


Figure 8-1. Review and Update Activities

8.1 REVIEW PROGRESS



This activity begins in Step 5, Review and Update.

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OVERVIEW

Your objective in this activity is to perform a formal review of the progress made in the current cycle in terms of the cycle and process improvement objectives. This includes comparing the actual measures of the implementation to those estimated in the action plan, examining success criteria to ensure they were met, and reviewing lessons learned. You will analyze how the progress made in the current cycle impacts the remainder of the process improvement program. This information will be used in the define/update program plan activity to develop planning documents before obtaining commitment to proceed. You will also baseline the process assets created or updated during this cycle.

In performing this activity, explicitly and actively solicit participation from all stakeholders during the decision process.

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START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:

- Approved action plan for this cycle
 - Approved program and cycle objectives, constraints, and strategy
 - Data and results from the implementation
 - Process assets created or updated during this cycle
 - Description of lessons learned in this cycle
-

TASKS

You will compare the implementation progress to the cycle and program objectives and to the cycle success criteria, review lessons learned, and baseline the process assets.



\$



1. Compare Implementation Data to Objectives. You need to understand the progress made toward this cycle's implementation objectives and the overall program objectives. You will not perform these tasks until all or part of the implementation has been completed.

Cycle 1,2

This task is not performed until adequate sponsorship is established.

Cycle N

Analyze the data gathered during the implementation for the following:

- **Process User Satisfaction.** It is important to understand how the process users perceive the improved processes. Did they consider the improved process(es) to be a success? Were they satisfied with how the process(es) worked? Did the users feel they were adequately trained and supported?
- **Sponsor Satisfaction.** Was the implementation considered a success by the sponsors? Did they feel that they are getting a positive return on their investment?
- **Process Improvement Program Strategy.** Did the realities of the implementation stray from the original strategy? If the implementation was not aligned with your program strategies, then revisit your selected program strategy and alternative strategies to determine if the most appropriate strategy was selected.
- **Process Improvement Program Objectives.** Did the implementation make progress toward the program objectives? If not, then examine your cycle objectives to determine if they were aligned with the program objectives. You may begin to lose management commitment and sponsorship if you do not make progress toward your goals.
- **Cycle Strategy and Objectives.** Did the implementation meet your success criteria for your cycle? If not, were your cycle objectives unrealistic? Did you select a viable cycle strategy? Did the realities of implementation cause you to deviate from your cycle strategy?
- **Other Impacts.** Consider other impacts to your implementation that were unforeseen during the planning stage. These impacts may have included:
 - **Indirect Impacts.** Sometimes a completely new process may have a wider effect than can be foreseen. This may include permanent changes in job duties, organizational structures and processes, or skill demands. Analyze the implementation for any indirect impacts.



Sponsor



Champion

Process
UserChange
Agent



- **Implementation Processes.** Among the impacts of implementing new processes are those that are tied to the implementation process itself. Understand any side effects, such as the before versus after perturbations of organizational life.

Document your analysis of the above issues in an evaluation report. Include an analysis of risks (did you identify the major risks?) and whether risk mitigation plans were successful. Record lessons learned for use in subsequent planning.



2. Review Lessons Learned. You need to build awareness of the experiences of the organization so that, during the next cycle, you do not repeat those experiences that had negative side effects, and you reinforce those experiences that had positive side effects.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Review the lessons learned gathered in Step 4, Implement Improvements, with the organization as a whole. Modify the lessons learned document, based on feedback from the organization.



3. Baseline Process Assets. It is important to maintain a collection of artifacts that are valuable resources to the organization. These assets can be stored in many way; a process asset database or library are two such ways.

The process database can be used to store actual measurement data related to the process and work products, such as:

- Estimates and actuals of software size, effort, cost, and schedules
- Estimates and actuals of process improvement activities
- Productivity data
- Peer review coverage and efficiency
- Number and severity of defects found in software

The library can be used to store process-related documentation, such as:

- Organizational policies, procedures, and standards
- Tailoring guidelines and criteria for projects
- Software development plans

\$ Sponsor



Champion



Process
User



Change
Agent



- Risk management plans
- Measurement plans
- Process training materials
- Lessons learned

This information, in both the library and the database, is an important resource to the organization and can help to reduce the amount of effort required to initiate a new project by providing examples and templates to build from.

Cycle 1,2 This task is not performed until adequate sponsorship is established.

Cycle N Archive the process assets into a process asset database, process asset library, and/or some other storage mechanism for future reference.

.....

MEASURES

In order to quantify the resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:

- Time and effort spent comparing implementation data to objectives
- Number of program/cycle objectives achieved
- Time and effort spent reviewing lessons learned
- Time and effort spent baselining process assets
- Number of process assets baselined
- Size of each process asset
- Quality of each process asset
- Number of action plan items successfully completed
- Number of recommendations successfully completed

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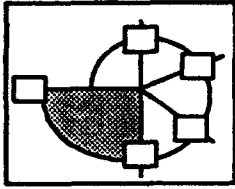


STOP CRITERIA

This activity is complete when:

- You have reviewed the cycle and program objectives and the actual implementation performance with sponsors
- You have reviewed lessons learned with the organization
- You have baselined all process assets

8.2 DEFINE/UPDATE PROGRAM PLAN



This activity begins in Step 5, Review and Update.

.....

OVERVIEW

Process improvement does not just happen. It requires a detailed plan that sets the direction of process improvement, outlines the basic steps to get there, and identifies milestones that can be used to demonstrate progress. It is well worth your time to invest in developing a solid plan to guide your process improvement program.

A typical plan consists of six interrelated topics (Harrington 1987):

1. **Mission.** This is the stated reason for existence. Although the mission changes infrequently, it is usually modified when the organization pursues a new market.
2. **Operating Principles.** These are the basic beliefs of the organization. These principles are reflected in the culture of the organization and rarely change.
3. **Business Objectives.** These objectives set the long-term direction of the organization.
4. **Performance Goals.** These are quantifiable results that the organization wants to accomplish in a period of time to support the objectives.
5. **Strategy.** The strategy defines the way the performance goals will be implemented to achieve the objectives.
6. **Tactics.** The tactics define the specific tasks to perform in the short term to move toward the performance goals.

Your objective in this activity is to develop a detailed plan for a process improvement program and to update these plans based on the previous cycles and lessons learned. Contents of the plan will be based on information from many sources, including any risk analysis work done in the Analyze and Resolve Risks activity (in Step 2) and your analysis of the implementation progress conducted in the Review Progress activity (in Step 5).

.....

START CRITERIA

Use the following types of information and/or working knowledge as inputs to this activity:



- Process improvement program strategy, objectives, and constraints
 - Cycle strategy, objectives, and constraints
 - Draft risk management plan developed in Step 2
 - Data gathered during any implementation conducted in this cycle
 - Results from the Review Progress activity
-

TASKS

You will define recommendations to senior management on how to proceed with process improvement, based on the new or updated process improvement program plan. This plan includes estimates for the budget and schedule for the first three steps in the next cycle.



1. Define Recommendations and Develop/Update Program Plans. Define your recommendation(s) for how the program should proceed in the next cycle and develop/update the process improvement program plan accordingly, including budgets and schedules for the next cycle.

Cycle 1

In the first cycle, you plan the entire process improvement program and the next cycle. Your plan is based on the program strategy, objectives, and constraints, and the results of the risk analysis performed in the Analyze and Resolve Risks activity (in Step 2). Specifically, you need to do the following:

- Develop a long-range strategic plan for improving the processes in your organization. Include the long-range goals of the program, the general order in which improvements will be performed, the stakeholders needed (both authorizing and reinforcing), and the recommended infrastructure (SC and PG) and their roles.
- Develop a budget and schedule for the program.
- Develop a draft plan for the next cycle (Cycle 2). This includes estimates for the resources and budget needed to address sponsorship and infrastructure issues, analyze and avert program risks, select the program strategy, update the program plan, and prepare the cycle plan.

Cycle 2

In the second cycle, you both established strong sponsorship for process improvement and increased the level of organizational readiness (in Analyze and Resolve Risks activity, Step 2). In this activity, you update the

\$ Sponsor



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Process
User



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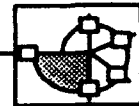


program plan, including budgets and schedules, based on insights from sponsors and issues of organizational readiness. You also develop a plan for the first three steps of the next cycle, including conducting an assessment of your organization's processes.

Cycle N

When updating the program plan (strategic), you use the implementation analysis you performed in the previous activity, Review Progress, and as much quantified information as possible as the basis of your changes. Specifically, you update the program plan, update the budget and schedules, and plan the first three steps of the next cycle, Understand Context, Analyze Risks and Select Strategy, and Plan Improvements.

- **Program Plan.** Update the program strategy and objectives, based on the results of the cycle implementation. Numerous scenarios may affect your program strategy, including the following:
 - The implementation went well, and the process improvements should be expanded to more of the organization (opening the door to institutionalization). In this case, other projects should follow the plan used for the pilot projects, taking into consideration lessons learned. Deviations from that plan may cause different results.
 - The implementation went well, but minor changes should be made before institutionalizing it throughout the organization. In this case, the same PAT may be tasked to make minor changes to the improved process.
 - The organization should continue with implementation of this cycle's objectives to resolve issues. This situation occurs when the implementation was incomplete or experienced difficulties. Consider re-implementing previous cycles and reconsider people's assignments.
 - The organization should re-evaluate the entire situation since the implementation was perceived to be a failure.
 - **Update Budget and Schedule.** When updating the budget and schedule for the process improvement program, remember to allocate time and resource contingencies to address such issues as emerging resistance, waning management commitment, and interference by other seemingly independent changes. It is important that the program plan anticipate and plan for these problems.
 - **Plan Next Cycle.** Based on the results of the implementation and its impact on the program plan, allocate resources and budget to conduct the first three steps of the next cycle.
-



MEASURES

In order to quantify the resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:

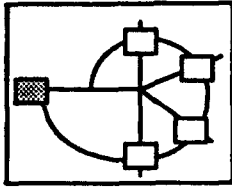
- Time and effort spent defining recommendations and developing program plans
- Size of program plan
- Quality of program plan
- Number of recommendations

.....

STOP CRITERIA

This activity is complete when you have defined or updated all program plans, as needed, based on the results of the current cycle.

8.3 COMMIT TO PROCEED



This activity begins in Step 5, Review and Update.

.....

OVERVIEW

Your objective in this activity is to get all stakeholders—including sponsors, champions, change agents, and process users—to commit to proceed with the process improvements based on the program plan you defined in the Define/Update Program Plan activity. A key part of this activity is for the sponsors to publicize their commitment across the organization. To get the commitment to proceed, ample opportunity should be provided for the stakeholders to review and comment on plans. Based on the review results, you may determine that you need to revise the plans.

.....

START CRITERIA

Start this activity when you:

- Have developed a plan for how the overall process improvement program and the first part of the next cycle should be conducted, including a budget and schedule
 - Understand who are the stakeholders for this activity
-

TASKS

You need to get a commitment from the identified stakeholders to proceed with the process improvement program based on the program plan.



1. Obtain Agreement From Change Agents, Champions, and Process Users. Seek agreement first from all stakeholders other than the sponsors on the direction of the process improvement program. The sponsors may be reluctant to approve the plan until there is buy-in from the other players involved.

\$ Sponsor



Champion



Process
User



Change
Agent



Cycle 1 In the first cycle, you look for agreement only from the change agents and champions who have been working on the initial improvement plan.

Cycle 2...N In all other cycles, you look for agreement from the change agents, champions, and process users.



2. Obtain Commitment From Sponsors. After you have buy-in from all champions, change agents, and the process users, you present your plan to the sponsors for approval and commitment to proceed. Your presentation should include:

- Description of the plan, including suggested assignments or responsibilities for the program
- Your rationale for the plan, including justification for the overall objectives of the program (both long- and short-term benefits)
- How the execution of this plan will impact each part of the organization, especially those groups related to the sponsors you are briefing
- Estimated cost and time frame for the implementation of this plan

Depending on your situation, you may decide to stagger the presentations, targeting first those sponsors who are more supportive, in order to build a stronger case for those sponsors who are less supportive.

In all cycles, you will look for commitment to proceed with the program, based on your program plan. The plan describes program strategy, a budget and schedule, and a specific plan for how to proceed with the first three steps of the next cycle.

Cycle 1 This task is not performed until adequate sponsorship is established.

Cycle 2...N In all other cycles, you will seek commitment from the authorizing and reinforcing sponsors.



3. Publicize the Commitment. After approving the action plan, the sponsors need to publicize their support and commitment throughout their organization to keep everybody informed, to reinforce the importance of process improvement, and to help prepare everybody for the changes ahead.

Cycle 1 This task is not performed until adequate sponsorship is established.



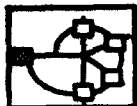
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Process
User



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Cycle 2...N

Assist the sponsors with developing a communication strategy to publicize commitment. Use the influence strategy created in Step 1, Understand Context.

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MEASURES

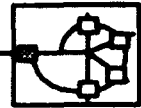
In order to quantify the resources spent on process improvement, and to improve the process improvement process itself, collect the following measures:

- **Time and effort spent reviewing the plans with change agents, champions, and process users**
 - **Number of persons interacted with during the review**
 - **Time and effort spent developing a management presentation**
 - **Size of the management presentation (e.g., number of charts)**
 - **Quality of the management presentation**
 - **Time and effort spent meeting with sponsors**
 - **Number of presentations to and meetings held with sponsors**
 - **Time and effort spent publicizing the commitment**
 - **Number of persons to whom and places where commitment was publicized**
-

STOP CRITERIA

This activity is complete when:

- **You have secured commitment from the sponsor to proceed with the program, based on the program plan**
- **The sponsors have publicized their commitment to the organization**



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9. IMPROVING YOUR PROCESS IMPROVEMENT PROCESS

Practice what you preach.

Anonymous

Section Objectives

1. Provide general guidelines for improving your organization's process improvement process

2. Summarize what an organization would be like that performed its process improvement well

In contrast to Sections 4 through 8 of this guidebook, which provides specific, step-by-step guidance on how to improve your process, this section provides generic guidelines for improving your organization's overall process improvement process. The previous sections cover the launching of a process improvement program in considerable detail; this section emphasizes aspects that are commonly still in need of improvement after this initial launching.

Organizations differ widely in the ways they address process improvement: some handle it as stressful episodes; others try to learn from each improvement, but are poor at applying any lessons; and still others treat process improvement as a "core competency" with organizational structures, processes, and incentives aimed at maximizing their competitive advantage in this area. This section covers variations among organizations and provides strategies you can use to improve your own process improvement process. It presumes that you are seriously interested in improving your process, will attempt to do so frequently, and can learn to organize and optimize systematically the process improvement process and its context over these many improvements.

While the earlier sections of this guidebook address improving the software process, the same principles enunciated there apply to improving the process improvement process. This section applies these principles in the larger organizational context to the process improvement program itself.

In this section, you will learn how, with adaptations for your situation, to change your organization's context for process improvement (e.g., culture, infrastructure, and external relationships) and your direct process improvement effort itself (e.g., involvement, engineering, and management). A brief vision of your future organization is also provided.

9.1 ORGANIZATIONAL CONTEXT

Instead of viewing the process improvement process as an isolated set of activities that you initiate each time you want to improve your process,

consider process improvement to be an ongoing function with a permanent set of organizational processes and relationships.

From this perspective, process improvement involves the managed exchange of information and resources, both within your organization and with related, external organizations. Figure 9-1 shows a number of organizations and conditions that affect process improvement, as well as the subsystems mentioned in Section 2.

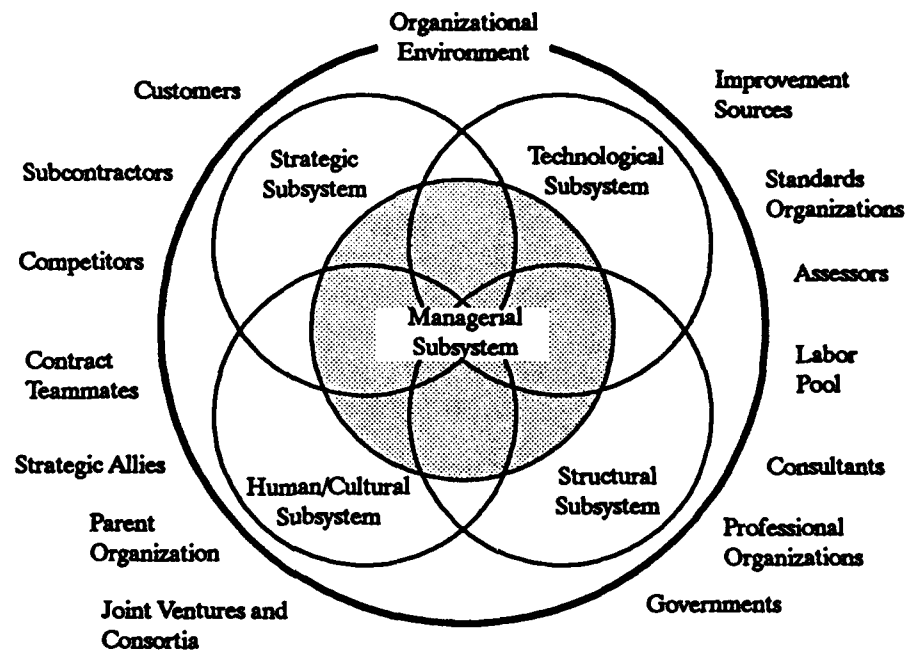


Figure 9-1. Organizational Context

When an organization views process improvement as an ongoing function, organizational arrangements to handle technologies and process improvements may be instituted and improved. The next sections provide guidelines for these organizational arrangements and practices in the areas shown in Figure 9-1:

- Strategy
- Organizational culture
- Organizational structures and infrastructures
- Management
- Technology
- External entities and relationships

Each section briefly describes the relationship of each area to process improvement and then lists guidelines, organized by topic, that will help your organization improve within that area.

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STRATEGY

You improve your process not for its own sake, but for the advantages, both immediate and strategic, that improvement provides. In order to maximize these advantages, concentrate on process improvement considerations and their role in strategic efforts and strategic and tactical planning.

Be visionary and aware of process improvement in your strategic and tactical planning.

- Examine politics and international competitiveness as part of the organizational context. Consider not only potential global markets, but global sources of improvement and technology. Ensure that this information is received and used by those who need it.
 - Align process improvement efforts with the increasing scope of corporate change goals. Five stages, adapted from Venkatraman (1991), are (1) localized improvements of increasing scope, (2) improvement integrated internally across organization, (3) business process redesign, (4) business network redesign, including suppliers, customers, and others; and (5) business scope redefinition, where new processes and technology are used to change the organization's mission, scope, markets, and products.
 - Use strategic, organization-wide improvement efforts as the impetus and resources to improve your process improvement effort and plan future strategic process improvement efforts. Current common strategic improvement efforts include TQM, the ISO 9000 series of quality management system certification, and U.S. Department of Commerce's Malcolm Baldrige Quality Awards.
 - Become more proactive in process improvement by exploiting and retaining the initiative to influence future events (e.g., influencing standards' directions); making quicker, better decisions regarding improvement directions and use; and achieving flexibility to avoid adverse events (e.g., developing an agile culture of rapid change that allows you to enter new markets when old markets fade away).
 - Consider technology and process improvement needs, plans, and opportunities in planning the capability of your organization. Involve management and/or staff who provide resources, serve as sponsors, or promote process improvements.
-

ORGANIZATIONAL CULTURE

From an organizational viewpoint, process improvement is more than a simple behavior that can be called upon only when needed. It is a complex set of knowledge, skills, values, norms, behavioral patterns, and ongoing activities that few technically educated persons learned in school or fully mastered early in the workplace. In order to maximize your organization's success at process improvement, you must direct considerable attention at building and nurturing a culture that supports and encourages the process.

Develop a culture that supports process improvement.

- Establish management commitment from the top down to a culture that supports changes that lead to improvements in practices.
- Through a broad consensus process, establish an organizational mission and organizational values statements that recognize and encourage ongoing improvement and openness to outside ideas and technology. Make sure your policies and procedures support these new statements.
- Ensure that management and staff understand the need for process improvement throughout the organization, including a long-term understanding of the position of process improvement in your business strategy.
- Examine the supporting values of the organization by examining norms on risk management, openness to change, beliefs on what is needed to survive and prosper; staff empowerment; commitment to TQM; customer orientation; and self-image as a leading-edge organization.
- Use the eleven-step scale (shown in Figure 9-2) to determine local cultural norms in handling risk or need to change (Grove 1983; Charette 1992; Redwine 1986; Sage 1993). Systematically raise the level of individuals and the organization on this scale.
- Train management and staff on process improvement principles and techniques. This can include training in process, process improvement process, action planning, and interpersonal skills and human behavior.
- Support a culture of professionalism and lifelong learning. Pay for reasonable professional memberships, activities, and certification. Expect professionalism in all activities. Train and educate your management and staff in new software engineering-related skills and knowledge. Most computing-related skills and knowledge have a half-life of five years or less, and requires continual training and education of software management and staff.

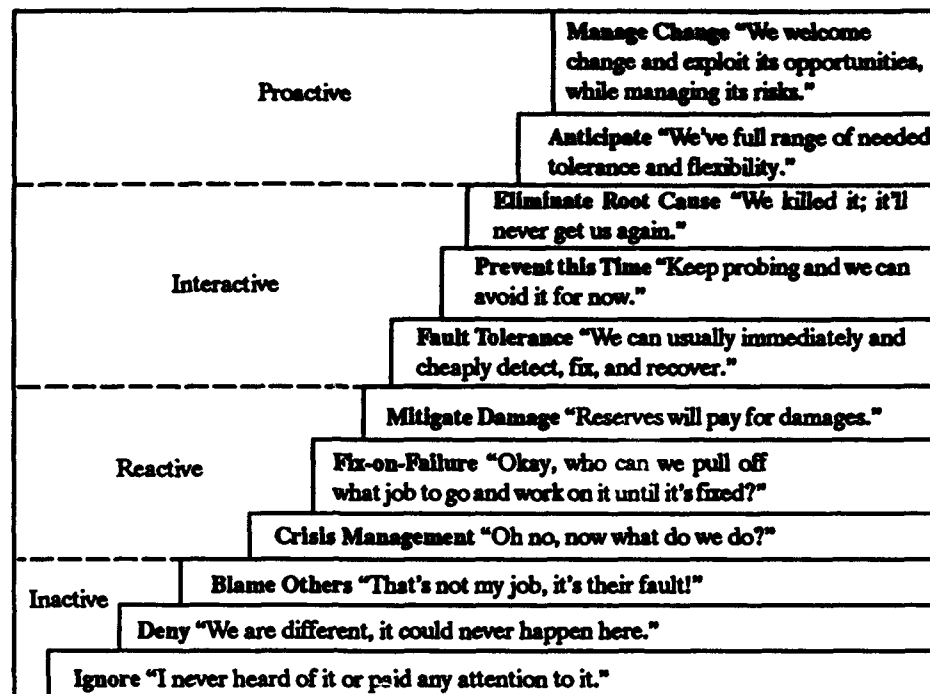


Figure 9-2. Eleven-Step Scale for How Organizations React to Risks or Need to Improve

ORGANIZATIONAL STRUCTURES AND INFRASTRUCTURES

Your organizational structure and infrastructure must change to incorporate new improvement strategies and cultural practices. These changes may involve new functions and groups or new relationships among those that already exist.

Ensure that organizational structures exist to support process improvement.

- Use your human resource department to ensure availability of expertise, skills, and training in process and process improvement.
- Create a technology organization that identifies and tests new technologies and helps bring them into the organization. Consider carefully its relationship with the rest of the organization, staffing (including rotation), resources, duties (to identify, not invent), organizational placement, and permanence.
- Develop a permanent internal training capability to develop and/or customize training materials rapidly, deliver them successfully, and maintain ongoing training support. This requires specialized expertise in professional training and instructional design.
- Use a process improvement group, such as the PG, to facilitate the introduction of improvements and new technology.

- Have an SC, including line managers, that possesses the resources and authority needed for improvement.

Ensure that infrastructure mechanisms exist to support process improvement.

- Develop measurement programs that establish baselines and measure progress toward process improvement. Refer to *Software Measurement Guidebook* (Software Productivity Consortium 1992b) for information on how to set up a measurement program.
- Develop guidelines for institutionalizing a process (e.g., how to revise budgeting, infrastructure procedures, and job descriptions).
- Coordinate and refine the roles in process improvement for such areas as technical support, configuration management, the technical library, and purchasing.
- Create information repositories of previous process improvement experiences to assess the impact of a change and to allow you to improve your process continuously by learning from past mistakes. Capture the “folklore” of managers and staff who “tell their story” and a more objective, common set of elements, such as what improvement mechanisms were used, the role of users, and the decision-making process. Information on past process improvement experiences can help you plan and predict future improvements. Information on plans can allow projects to integrate their improvement approaches. The repository need not be in one central place, but it should be easy to access.
- Migrate toward open hardware and software environments that support addition and/or modification of technologies.
- Integrate the organization’s process improvement process with other organization-wide processes (e.g., TQM) and with any strategic planning processes or groups.
- Establish an organizational assessment and analysis capacity, and use it regularly. This should help you understand where your organization stands in regard to process, technology, and other changes.
- Be alert to and consider ways that your organization can distribute expertise among staff, thereby reducing reliance on individual specialists while at the same time increasing flexibility. This might include changing the extent and speed of information flow, flow of expertise and people, ease of organizational learning and improvement, and advocacy for unbiased evaluation methods and multidisciplinary knowledge.

- Develop process improvement awareness mechanisms (technical libraries, network services, outside database/library services, domain experts, benchmarking, and technology receptor organizations) that help staff identify improvements.
-

MANAGEMENT

The management of the process improvement effort involves the full range of management issues. Many of the points made elsewhere in this section have management components. The guidelines here directly address managers of process improvement efforts.

Be an example of a well-run effort.

- Set explicit, realistic objectives and goals, both near- and longer-term.
- Model desired process behavior. While one cannot reasonably expect your process improvement program to be much better organized and executed than your projects, strive to model the next round of improvements desired of such projects. For example, if you expect projects to use sound estimating procedures, then the process improvement program should use them; or, if you are aiming toward having a defined software process, then the process improvement program should define its process first.
- Build a culture within the process program that climbs the eleven-step scale (Figure 9-2) ahead of the rest of the organization.
- Explicitly manage uncertainty and risks. Do not allow anyone's myopic concern for ROI guarantees to divert you from doing the right thing. Process improvement economics is in its infancy. Though management understands the need to be successful at process improvement, a detailed understanding of the costs versus the benefits of following a defined process improvement process does not yet exist.
- Conduct your own explicit process improvement effort.

Be customer driven.

- Listen to process users and the SC. Consider the agony, the money, and the needs of the process users and their customers in deciding what to do. Motivated process improvement users are key to success.
- Increase sponsor and management commitment and enthusiasm by building increasingly open, warm, ongoing relationships with more key persons.

- Rotate process users through the process improvement program and teams.
- Establish validated requirements for your process definition efforts.
- Measure diffusion, success, and satisfaction.

Integrate process improvement.

- Involve yourself in all related planning (including budgeting) and with similar initiatives.
- Increase awareness, coordination, and integration among process improvement and technology efforts throughout the organization.
- Ensure that the process improvement program's own processes integrate smoothly with other organizational processes.

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TECHNOLOGY

The technological subsystem covers issues such as: Are the processes used to transform inputs into outputs standardized and institutionalized? Do the processes rigidify operations, or are they flexible? What types of technologies are being used? Institutionalization is the extent to which the use of the process is routine, widespread, and embodied in the organization's governance mechanisms.

In your process engineering, use the best practices and ideas from systems engineering, organizational development, process improvement, user, and other communities.

- Take increasing advantage of the existing expertise, both inside and outside your organization, to improve your state of practice in process engineering. See *Process Definition and Modeling Guidebook* (Software Productivity Consortium 1992a) and *Process Engineering With the Evolutionary Spiral Process Model* (Software Productivity Consortium 1993b).
- Insist on professionalism in process engineering. Pay for reasonable professional memberships, activities, and certification. Expect knowledge of limitations, combined with professional networking and paid assistance, to find answers.
- Support learning. Train and educate your process management and staff in new process engineering-related skills and knowledge. Most software process knowledge and skill has an even shorter half-life than regular computing knowledge; this requires continual study, training, and education.

- Emulate the best involvement mechanisms in use in your organization (e.g., Integrated Product Teams (IPTs) or concurrent engineering teams).
- Pay attention to process requirements and architecture.
- Ensure that processes result in meaningful, interesting, and enjoyable jobs.
- Use process (re)design expertise to improve process speed, dependability, cost, and resulting customer satisfaction.
- Cultivate the persons performing the process to become your biggest source for improvement suggestions—then use them.

Stay on top of new process developments.

- Access and digest relevant periodicals, market reports, and government studies. Subscribe to services, databases, and analysis groups.
- Use traditional and nondirectional, and local and global sources for new processes and technology. Traditional sources include consulting firms, colleagues, literature, seminars, internal research and development (R&D) laboratories, universities, computer manufacturers, tool vendors, and meetings. Less traditional, but sometimes even more effective, sources include joint ventures, consortium membership, federally funded R&D centers, competitors, suppliers, and customers.
- Participate in or track appropriate standards projects.

Exploit automation.

- Use office automation to manage and communicate.
- Use automation to support process definition and modeling. See *Process Definition and Modeling Guidebook* (Software Productivity Consortium 1992a).
- Evaluate and pioneer process enactment or workflow management tools within the process improvement effort.

Integrate software-related processes.

- Ensure that software processes and methods integrate well.
- Integrate software processes with related processes, such as systems engineering process and marketing process.

Institutionalize process improvement.

- Define the process improvement process and evolve the definition.
- Achieve a workforce skilled in its use.
- Embody in organizational governance mechanisms, such as policies, procedures, measurements, reports, reviews, assessments, and audits.
- Use universally (except for explicit, managed, purposeful pilot changes).
- Incorporate in initial personnel indoctrination and training, and other mechanisms of acculturation.
- Reinforce to prevent slowly fading away.

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EXTERNAL ENTITIES AND RELATIONSHIPS

In order for your organization to be a permanent leader in process improvement, it must develop stable and long-term relationships with important external organizations, including your customers, suppliers (e.g., vendors and consultants), and industrial peers.

Ensure strong and improving relationships with external organizations.

- Encourage staff, user, supplier, and customer involvement in decisions that affect them.
- Attempt to establish relationships to facilitate codesign of processes by supplier-customer pairs or chains with your subcontractors and clients.
- Form ongoing relationships with select process improvement and technology sources. This can take such forms as industrial liaison relationships with universities, contracts, joint ventures, consortia, periodic benchmarking, strategic alliances, investment, or cross-ownership. Ongoing relationships will help facilitate transfer, give you advance insight and influence on how new processes might fit into your environment, and promote ongoing support for the transfer from the source.
- Provide a vehicle for systematically asking customers and suppliers about their immediate and expected future process and technology needs and changes.
- Carefully select and form a relationship with assessor organization(s) and personnel that can come to know your organization and approach to improvement.

- Find ways (e.g., industry surveys, benchmarking, visits, business intelligence) to compare your organization's process and process improvement program to that of your competitors.

9.2 WHAT YOUR ORGANIZATION'S FUTURE SHOULD BE

Assuming that all or most of the preceding suggested guidelines have been followed to conclusion, you will work in a new type of organization. This section outlines a vision of what it should be like, covering the same six areas as the prior section. (Steele [1989] offers a somewhat similar view of the "technologically effective organization.")

- **Strategy.** The organization will take an explicit systems view of process and process improvement in the context of the organization and its objectives, strategies, and environment. Likewise, recognition of the implications of technology and technology change will be pervasive in the management and operation of the enterprise. The open computing environment, people, organization, processes, products, and external relationships will evolve together to achieve continuing overall improvement and success.

Your organization will take a global approach to the changing nature of competition, both in the players and the basis for competition. Your organization will recognize in many markets the basis of competition shifting toward quality, total customer satisfaction, speed to market, solutions rather than means, custom fit at mass-market prices, customer delight, technical compatibility, corporate virtue, and long-term relationships.

- **Organizational Culture.** Your organization will change proactively at a rate that will be uncomfortable, but not debilitating. No process or technology will be totally sacred or unchangeable. The rate of change will be fast enough to respond to, and even shape, the external considerations that necessitate change.

All parts of the organization will be improvement-oriented, including enterprise-wide TQM efforts, which will result in relentless removal of the causes of and opportunities for defects, as well as improvements of all sorts, including technological ones. TQM-style benchmarking will help many organization functions compare themselves to the best-known state-of-the-art practice.

- **Structure and Infrastructure.** While organizational arrangements may vary, the process expertise and functions will be official, effective, efficient, and improving—world class. Training, support, and other infrastructures will exist as part of an institutionalized approach to process improvement. Human resources and careers will be managed such that selection, education and training, assignments, and departures result in the needed skill mix at the time needed.

- **Management.** Your organization will be self-aware, using both an institutionalized measurement program and periodic self-assessments, in both technical and nontechnical areas. It will have defined explicit success factors and will report on levels of process, and technology use and mastery. It will be able to tell incompetence or error from bad luck—and act accordingly.

Process and other risks will be managed and mitigated. This will be part of dealing with the ongoing tensions between exploiting current capabilities and advantages, and creating new ones—the crunch between doing something the old way, versus spending time and money to learn and master a new way. Multiple alternatives will be vigorously sought and objectively selected among.

- **Technology.** Recently begun projects will use a modern, reasonably integrated set of technologies and processes tailored from the organization's process guidance. Most of these projects will try something new, however, in a stage of the development process as part of the organization's systematic and sanctioned exploration and learning activities. Older projects will upgrade their process and technology more slowly, but will follow defined management and technical processes. Process improvement and technology awareness, exploration, and transfer will be explicit and will follow defined processes and methods integrated into your organization's processes and methods, particularly for TQM and systems engineering, but also for the full set of the enterprise's processes.

Knowledge and skills will flow rapidly and systematically into and through the organization to all the places they are needed or usable. While not neglecting mastery and continual improvement of present processes, the organization will look multiple technology generations ahead for relevant technologies: product, process, and informational.

- **External Entities and Relationships.** The world that you and your organization live in will be an accelerating, increasingly exciting, and potentially hazardous one. In your well-organized enterprise, however, the interest and excitement of all concerned (manager, technologist, and user) in engaging the world and successfully advancing the process and technology used in your organization will exceed any discomfort involved.

The organization will know about competitors, both current and potential, and will produce objective comparisons. It will explicitly exploit process for enhanced competitiveness.

Key technical personnel and management will have active external interactions—particularly with customers, but also with sources of improvements, peers in your profession and industry, subcontractors,

government, and academe. Attention and interaction will not be parochial in terms of organization, geography, or discipline.

Realistic decisions will be made on in-house process improvement development versus obtaining it from outside. Nondisclosure agreements, alliances, and joint ventures such as consortia will be formed with customers, teammates, and/or suppliers to understand, forecast, and achieve the technology (and other factors) needed for success. Your organization will have learned how to manage and practice these types of collaboration.

9.3 CONCLUSION

Essentially, this section focuses on how your organization's process improvement program can routinely perform better the business of process improvement and offers a vision of where that should lead. Moving to this vision, however, can only be done incrementally. You can best follow the guidelines incrementally by adopting the underlying management approach first outlined in Section 3 and applying it to this section's larger context.

Improvements in your process improvement program should be mutually reinforcing, with improvements in your strategy, culture, and structure that ensure that you create supportive internal and external arrangements, policies, procedures, and practices. Altogether, obviously, this involves a major process of organizational development that serves both to create a more change-oriented organization and to make each process improvement more integrated with the organization's vision and culture—and more routine.

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APPENDIX A. CHECKLISTS FOR APPLYING THE PROCESS IMPROVEMENT PROCESS

Appendix Objective

Provide checklists to guide you through the implementation of the process improvement process

The guidance that is provided in Sections 4 through 8 presents the process improvement process from a step/activity/task perspective. The guidance is ordered by step, activity, and task, with the guidance tailored for each cycle (1, 2, and N) within each task. Cycle N represents all cycles following the first two.

This appendix provides you with a different view into the process improvement process. Instead of ordering by step/activity/task, the ordering is presented by cycle. Specifically, for each cycle (1, 2, and N), this appendix provides a checklist that outlines the specific tasks you perform in each cycle. These checklists are based on the overall strategy for process improvement as described in Section 3.3, Locating Yourself in the Process.

Table A-1 provides the checklist for Cycle1; Table A-2 provides the checklist for Cycle 2; and Table A-3 provides the checklist for Cycle N. Each table includes a column for additional comments you may wish to note during the execution of the tasks.

Table A-1. Cycle 1 Tasks Checklist

Cycle 1 Tasks	Additional Comments
<p>1. Step 1: Understand Context</p> <p>Activity: Build Sponsorship and Foundation</p> <ul style="list-style-type: none"> <input type="checkbox"/> Understand the implementation climate and organizational readiness <input type="checkbox"/> Prepare and execute influence strategy <p>Activity: Define Improvement Strategies</p> <ul style="list-style-type: none"> <input type="checkbox"/> Define objectives <input type="checkbox"/> Identify alternatives <input type="checkbox"/> Identify constraints <p>Activity: Review Context</p> <ul style="list-style-type: none"> <input type="checkbox"/> Obtain agreement from change agents, champions, and process users <p>2. Step 2: Analyze Risks and Select Strategy</p> <p>Activity: Analyze and Resolve Risks</p> <ul style="list-style-type: none"> <input type="checkbox"/> Identify and analyze risks <input type="checkbox"/> Review risk analysis <input type="checkbox"/> Evaluate and plan risk mitigation <input type="checkbox"/> Commit to the risk management plan <input type="checkbox"/> Execute risk management plan <p>Activity: Select Improvement Strategy</p> <ul style="list-style-type: none"> <input type="checkbox"/> Select a process improvement program and/or cycle strategy <p>Activity: Commit to Strategy</p> <ul style="list-style-type: none"> <input type="checkbox"/> Obtain agreement from change agents, champions, process users <p>3. Step 3: Plan Improvements</p> <p>No activities or tasks to perform in Cycle 1</p> <p>4. Step 4: Implement Improvements</p> <p>No activities or tasks to perform in Cycle 1</p> <p>5. Step 5: Review and Update</p> <p>Activity: Define Program Plan</p> <ul style="list-style-type: none"> <input type="checkbox"/> Define recommendations and develop program plans 	

Table A-1, continued

Cycle 1 Tasks	Additional Comments
Activity: Commit to Proceed <input type="checkbox"/> Obtain agreement from change agents, champions, and process users	

Table A-2. Cycle 2 Tasks Checklist

Cycle 2 Tasks	Additional Comments
<p>1. Step 1: Understand Context</p> <p>Activity: Build Sponsorship and Foundation</p> <ul style="list-style-type: none"> <input type="checkbox"/> Understand the implementation climate and organizational readiness <input type="checkbox"/> Prepare and execute influence strategy <input type="checkbox"/> Demonstrate sponsorship and commitment <input type="checkbox"/> Form a Steering Committee <input type="checkbox"/> Establish a Process Group <p>Activity: Define/Update Improvement Strategies</p> <ul style="list-style-type: none"> <input type="checkbox"/> Define/update objectives <input type="checkbox"/> Identify alternatives <input type="checkbox"/> Identify constraints <p>Activity: Review Context</p> <ul style="list-style-type: none"> <input type="checkbox"/> Obtain agreement from change agents, champions, and process users <input type="checkbox"/> Obtain approval from sponsors <input type="checkbox"/> Publicize commitment <p>2. Step 2: Analyze Risks and Select Strategy</p> <p>Activity: Analyze and Resolve Risks</p> <ul style="list-style-type: none"> <input type="checkbox"/> Identify and analyze risks <input type="checkbox"/> Review risk analysis <input type="checkbox"/> Evaluate and plan risk mitigation <input type="checkbox"/> Commit to the risk management plan <input type="checkbox"/> Execute risk management plan <p>Activity: Select Improvement Strategy</p> <ul style="list-style-type: none"> <input type="checkbox"/> Select a process improvement program and/or cycle strategy <p>Activity: Commit to Strategy</p> <ul style="list-style-type: none"> <input type="checkbox"/> Obtain agreement from change agents, champions, and process users <input type="checkbox"/> Obtain approval from sponsors <input type="checkbox"/> Publicize commitment <p>3. Step 3: Plan Improvements</p> <p>No activities to perform in Cycle 2</p>	

Table A-2, continued

Cycle 2 Tasks	Additional Comments
<p>4. Step 4: Implement Improvements</p> <p>No activities to perform in Cycle 2</p> <p>5. Step 5: Review and Update</p> <p>Activity: Update Program Plan</p> <ul style="list-style-type: none"><input type="checkbox"/> Define recommendations and update program plans <p>Activity: Commit to Proceed</p> <ul style="list-style-type: none"><input type="checkbox"/> Obtain agreement from change agents, champions, and process users<input type="checkbox"/> Obtain commitment from sponsors<input type="checkbox"/> Publicize commitment	

Table A-3. Cycle N Tasks Checklist

Cycle N Tasks	Additional Comments
<p>1. Step 1: Understand Context</p> <p>Activity: Build Sponsorship and Foundation</p> <ul style="list-style-type: none"> <input type="checkbox"/> Understand the implementation climate and organizational readiness <input type="checkbox"/> Prepare and execute influence strategy <input type="checkbox"/> Demonstrate sponsorship and commitment <input type="checkbox"/> Form a Steering Committee <input type="checkbox"/> Establish a Process Group <p>Activity: Define/Update Improvement Strategies</p> <ul style="list-style-type: none"> <input type="checkbox"/> Define/update objectives <input type="checkbox"/> Identify alternatives <input type="checkbox"/> Identify constraints <p>Activity: Assess/Understand Process</p> <ul style="list-style-type: none"> <input type="checkbox"/> Assess/understand your organization's current process <input type="checkbox"/> Identify recommendations for improvement <input type="checkbox"/> Develop a findings and recommendations report <input type="checkbox"/> Present the recommendations <p>Activity: Review Context</p> <ul style="list-style-type: none"> <input type="checkbox"/> Obtain agreement from change agents, champions, and process users <input type="checkbox"/> Obtain approval from sponsors <input type="checkbox"/> Publicize commitment <p>2. Step 2: Analyze Risks and Select Strategy</p> <p>Activity: Analyze and Resolve Risks</p> <ul style="list-style-type: none"> <input type="checkbox"/> Identify and analyze risks <input type="checkbox"/> Review risk analysis <input type="checkbox"/> Evaluate and plan risk mitigation <input type="checkbox"/> Commit to the risk management plan <input type="checkbox"/> Execute risk management plan <p>Activity: Select Improvement Strategy</p> <ul style="list-style-type: none"> <input type="checkbox"/> Select a process improvement program and/or cycle strategy 	

Table A-3, continued

Cycle N Tasks	Additional Comments
<p>Activity: Commit to Strategy</p> <ul style="list-style-type: none"> <input type="checkbox"/> Obtain agreement from change agents, champions, and process users <input type="checkbox"/> Obtain approval from sponsors <input type="checkbox"/> Publicize commitment <p>3. Step 3: Plan Improvements</p> <p>Activity: Define/Update Action Plan</p> <ul style="list-style-type: none"> <input type="checkbox"/> Establish a PAT for each major area of improvement <input type="checkbox"/> Task each PAT to develop a tactical plan <input type="checkbox"/> Task the SC to develop a tactical plan <input type="checkbox"/> Task the PG to develop a tactical plan <input type="checkbox"/> Incorporate each tactical plan into the action plan <input type="checkbox"/> Identify budget and staffing <input type="checkbox"/> Develop measures of success <input type="checkbox"/> Analyze risks associated with the action plan <input type="checkbox"/> Finalize the action plan <p>Activity: Commit to Action Plan</p> <ul style="list-style-type: none"> <input type="checkbox"/> Obtain agreement from change agents, champions, and process users <input type="checkbox"/> Obtain commitment from sponsors <input type="checkbox"/> Publicize commitment <p>4. Step 4: Implement Improvements</p> <p>Activity: Implement</p> <ul style="list-style-type: none"> <input type="checkbox"/> Implement the action plan <p>Activity: Manage and Monitor</p> <ul style="list-style-type: none"> <input type="checkbox"/> Manage the implementation <input type="checkbox"/> Gather implementation data <input type="checkbox"/> Support the PATs <input type="checkbox"/> Analyze risks associated with implementation <input type="checkbox"/> Manage resistance to change <input type="checkbox"/> Reinforce sponsor commitment 	

Table A-3, continued

Cycle N Tasks	Additional Comments
<p data-bbox="236 369 690 401">Activity: Review Process Improvements</p> <ul style="list-style-type: none"><li data-bbox="285 417 712 449"><input type="checkbox"/> Collect and review process assets<li data-bbox="285 468 766 499"><input type="checkbox"/> Collect and document lessons learned <p data-bbox="186 518 551 550">5. Step 5: Review and Update</p> <p data-bbox="236 567 530 598">Activity: Review Progress</p> <ul style="list-style-type: none"><li data-bbox="285 615 835 646"><input type="checkbox"/> Compare implementation data to objectives<li data-bbox="285 665 596 697"><input type="checkbox"/> Review lessons learned<li data-bbox="285 716 596 747"><input type="checkbox"/> Baseline process assets <p data-bbox="236 766 591 798">Activity: Update Program Plan</p> <ul style="list-style-type: none"><li data-bbox="285 814 931 846"><input type="checkbox"/> Define recommendations and update program plans <p data-bbox="236 865 563 896">Activity: Commit to Proceed</p> <ul style="list-style-type: none"><li data-bbox="285 913 964 976"><input type="checkbox"/> Obtain agreement from change agents, champions, and process users<li data-bbox="285 995 733 1026"><input type="checkbox"/> Obtain commitment from sponsors<li data-bbox="285 1045 588 1077"><input type="checkbox"/> Publicize commitment	

APPENDIX B. SOFTWARE PROCESS ASSESSMENT METHODS

Appendix Objective

*Describe methods that
support the activity
Assess/Understand the
Process*

This appendix enumerates and describes three software process assessment methods that support the Assess/Understand the Process activity presented in Section 4. The methods covered in this section are:

- SPA by the SEI
- Process Advisor by R.S. Pressman & Associates, Inc.
- ISO 9000 by the International Organization for Standardization

B.1 SOFTWARE PROCESS ASSESSMENT METHOD

The SEI, a federally funded research and development center of the Department of Defense, has refined a method for assessing an organization's process maturity and an underlying framework, the CMM.

The Software Productivity Consortium is a licensed vendor of the SPA method.

CAPABILITY MATURITY MODEL

Most engineers and managers are quick to identify problems within their organization, but get mired in heated debates about what improvements to make and in which order. For those people looking for lasting results, not just quick fixes, it is best to proceed in an evolutionary manner, with successive stages building on previous ones.

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Levels of Software Process Maturity

The CMM is a conceptual framework, based on state-of-the-art software practices, that guides organizations through five levels of process maturity, supporting the premise that continuous improvement occurs in small, evolutionary steps (Imai 1986). The CMM framework allows organizations to characterize their process maturity, establish strategic goals for process improvement, set priorities for immediate actions, and strive to establish and achieve a culture of software engineering excellence. Figure B-1 shows the five levels of maturity.

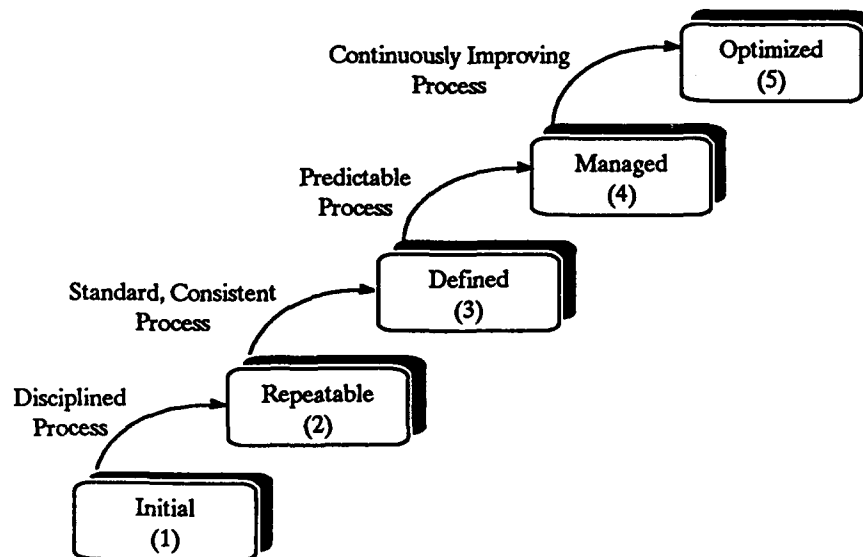


Figure B-1. Software Process Maturity Levels

Software process maturity is the degree to which a software process is explicitly and effectively defined, managed, measured, and controlled (Imai 1986). The implication of software process maturity is that organizations can improve their software process from one that is ad hoc and chaotic to one that is disciplined and consistent.

Immature organizations constantly operate in a fire-fighting, reactionary mode. They rarely meet schedules or budgets since they lack sufficient management planning of and visibility into software development activities. Lacking an organization-wide software process, immature organizations have no basis to predict or measure quality or to guide process improvement activities. Success, when it occurs, depends on the heroic efforts of individuals. Operating an organization in this manner leads to low employee morale and high burnout, possibly leading in turn to high attrition rates. The most costly effect may be the inability to meet customers' expectations.

Mature organizations have the capability to manage software development and maintenance activities successfully since these activities are based on an organization-wide software process. Roles and responsibilities within the software process are clearly defined, thus facilitating better communications among staff. Activities within the software process are measurable, providing a way to improve predictability of schedules, cost, and quality. Management can see progress and understand the effects of proposed changes, which results in informed decision-making.

Organizations at the **Initial Level** typically do not have sound management practices in place, thereby compromising the benefits of any software engineering practices that may exist. When a crisis occurs, any hint of a formal process is abandoned. The successes that do occur in organizations at the Initial Level are typically due to the efforts of dedicated individuals, without whose efforts the organization would founder.

Organizations at the **Repeatable Level** have established policies and procedures for managing a software project. Realistic project schedules are based on past experiences and project requirements. Project costs, schedules, and functionality are tracked. Level 2 organizations typically have a disciplined project management process that provides a basis for project planning and tracking.

At the **Defined Level**, an organization-wide standard software process exists for developing and maintaining software. This process is documented and covers both software engineering and management activities. Level 3 organizations have a dedicated team focused on software process activities. Projects may tailor the organization's software process to account for project-specific characteristics. Level 3 organizations are typically stable and consistent due to the effectiveness of the underlying organization-wide software process.

At the **Managed Level**, organizations begin to improve the predictability of projects by setting measurable quality goals for both the product and process. These measurements provide the organization with insights into better control of process variations. Level 4 organizations are best called predictable because of rigorous process measurement, and they operate within statistical control limits.

At the **Optimizing Level**, organizations focus on continually improving the efficiency of their software process. Defects in both the product and the process are prevented, and opportunities for technology innovations are identified and transferred throughout the organization. Level 5 organizations thrive on the culture of controlled change and improvement.

SOFTWARE PROCESS ASSESSMENT METHOD

The SPA is the primary activity for understanding an organization's software capability. The assessment activity is accomplished by performing four separate tasks:

- Assessment team selection
 - Assessment team training
 - Assessment participants briefing (APB)
 - On-site period (OSP)
-

Assessment Team Selection

The general criterion for selecting team members is that they should have a minimum of 10 years of experience in one or more of the following:

- Software development
- Project management
- Quality assurance (QA)
- Testing
- Configuration management
- PG experience

The individuals selected should be well respected in the organization and be credible with management. One ground rule should be that the individual is not currently responsible for managing a project or personnel that will be included in the discussion sessions of the assessments. This

relationship could hinder the flow of information. The Assessment Team Leader (ATL) should have the same qualifications, plus have experience in making presentations to peers and management. All members of the assessment team should be team players and should be interested in helping the organization improve its capability to develop software.

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Assessment Team Training

Training is typically conducted by a team of two professionals, both of whom have extensive SEI assessment experience, during a three-day period. Typically, the assessment training is facilitated by an individual authorized to lead an SPA.

The specific objectives of the SPA training course are to:

- Begin team building within the assessment team
- Provide understanding of the concept of a software engineering process
- Provide understanding of the framework of the SEI assessment process
- Provide hands-on experience in the assessment process through role playing using a detailed case study
- Provide a practical introduction of the SEI CMM into the assessment process

Training follows an agenda of lecture and student participation exercises. The training emphasizes the activities that are the most difficult to perform during the actual assessment. This is especially true of the use of role plays for project leader (PL) discussions and functional area representative (FAR) discussions, which are an important part of the assessment.

Toward the end of training, planning for the subsequent APB and OSP tasks is conducted. The planning involves:

- Defining the organization to be assessed
- Defining a project within that organization
- Selecting four to six projects to be assessed
- Determining the characteristics of a PL within the organization
- Defining requirements of and selecting the FAR groups
- Assigning the role of ATL and team coordinator

- Describing the related logistics that need to be considered for an assessment
- Outlining the structure and contents of the APB

The list of candidate projects typically should include at least five to seven projects. Typical considerations include:

- Size of project
 - Assigned PL
 - Length of project
 - Number of developers on the project
 - Current life-cycle phase that the project is working on
 - Application domain
-

Assessment Participants Briefing

The APB occurs during a two-day period. The events associated with the APB are shown in Figure B-2.

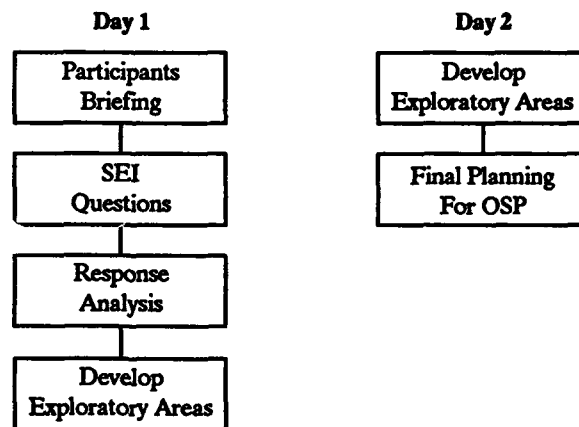


Figure B-2. Assessment Participants Briefing Activities

- **Participants Briefing.** This briefing includes a schedule of assessment events, including locations and times of these events, the designated participants, and an explanation of the importance of the free flow of information. Two potential concerns may inhibit the free flow of information:
 - The organization may be concerned that sensitive information about its software engineering capabilities may become known to its competitors or customers.

- Assessment participants may be concerned that information may be attributed to them by project or name.

Accordingly, the following rules, sometimes referred to as the confidentiality rules, are abided by the assessment team:

1. Only composite results are given to management.
 2. The assessment team and assessment participants agree to keep confidential all information disclosed during the course of an assessment.
 3. Since SEI collects the assessment data, it will not release or otherwise identify the results of any organization's assessment.
 4. The SEI is free to use assessment data and conclusions to be derived for statistical, analytical, or reporting purposes, provided that the confidentiality requirement can be honored and that the information can be used without attribution to its source, either directly or by inference.
 5. The SEI will not publish collective data externally unless such data is based upon information from not less than ten different organizations.
 6. Project-specific data is retained by the SEI.
- *SEI Questions.* The assessment team explains some of the key terms used in the questionnaire, and then the PLs respond to the questions.
 - *Response Analysis.* The responses are transcribed to a response matrix. The assessment team analyzes the response matrix.
 - *Develop Exploratory Areas.* The team develops exploratory questions, based on the analysis. The questions are then ranked and a script developed for each project.
 - *Final Planning for OSP.* The team reviews and verifies the logistics for the OSP in terms of the time and place each person or group will meet. Requests are made for any materials that may be required for the OSP, such as overhead projectors, whiteboards, paper, pencils, tape, etc.

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On-Site Period

The OSP, shown in Figure B-3, is the most critical activity of the assessment and requires the complete involvement and commitment of all team members. Because of the limited time available during the OSP, it is essential that the time is used effectively. Each event during this week is discussed below.

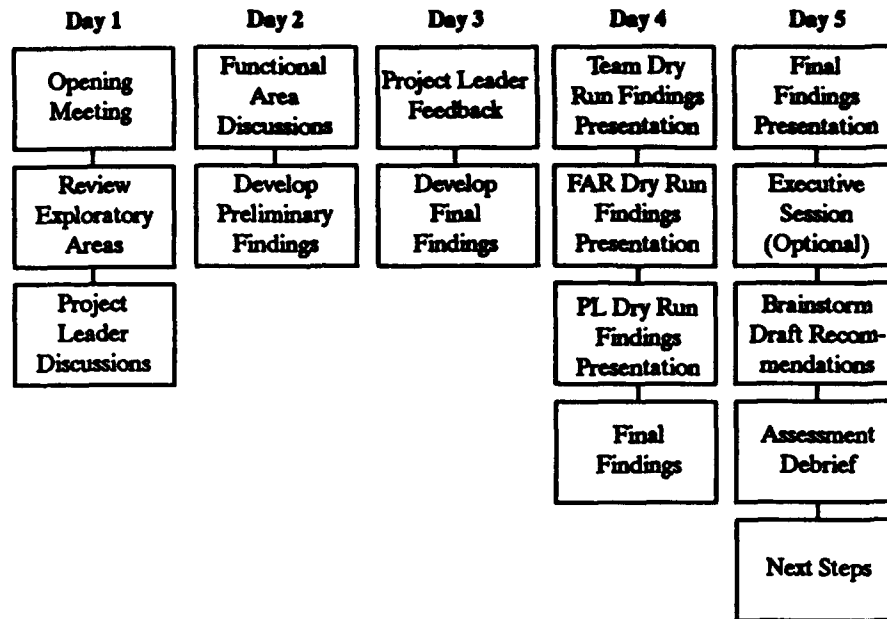


Figure B-3. On-Site Period Activities

- **Opening Meeting.** This briefing includes a schedule of the week's events, including locations, times, and designated participants.
- **Final Review of Exploratory Areas.** The assessment team verifies that the scripts developed during the APB are correct and properly ranked.
- **Project Leader Discussions.** These structured discussions are held individually with each designated PL and are guided by the script of exploratory questions developed during the APB period.
- **Functional Area Representative Discussions.** These discussions are somewhat different from the structured discussions with the PLs. A functional area is typically a group of working professionals who come from a representative functional area of a project. Usually there are four functional area groups, with eight to ten software professionals in each:
 - Quality assurance and release
 - Software integration and test
 - Code and unit test
 - Requirements and design
- **Develop Preliminary Findings.** The assessment team shifts its focus from data gathering to data interpretation by analyzing the data and developing preliminary findings. The role of the findings is to represent the assessment team's view of the most important software process issues currently facing the organization. The findings represent the starting point for formulating recommendations on how the organization needs to improve with regard to software process.

- **Project Leader Feedback Sessions.** A session is held with each of the PLs to review the preliminary findings.
- **Develop Final Findings Draft.** The final findings are a result of all the previously collected data, the team input, and the PL feedback to the preliminary findings. The structure of the draft final findings is different from that of the preliminary findings; the assessment team identifies the associated causes of each finding and resultant consequences.

An annotated outline of the final findings presentation can be found in Appendix C.

- **Dry Run Findings Presentations.** Before making a presentation to senior management, it is important for the ATL to perform dry runs of the presentation. The value of this is for the ATL to become completely familiar with the presentation material and also for the assessment team to receive feedback from the PLs and FARs to determine whether the findings are accurate and complete.
- **Final Findings.** This allows the assessment team to make any changes, based on the feedback from the dry runs, and to finalize the presentation.
- **Final Findings Presentation and Executive Session.** The ATL presents the final findings to senior management and the assessment participants. After making the findings presentation to management, an optional executive session is held. This session is conducted if senior management would like to gain some further insight into the assessment or findings.
- **Draft Recommendations.** The assessment team begins developing recommendations associated with the assessment findings while the week's activities are still fresh in their minds.
- **Assessment Debrief.** This debrief captures lessons learned to improve the assessment process, including the assessment team training, the APB, and the OSP.
- **Next Steps.** The purpose of this activity is for the assessment team to understand and plan the next steps, which are:
 - To develop a findings and recommendations report and briefing
 - To present a briefing to senior management on the recommendations
 - To begin planning process improvements

ADDITIONAL SOURCES OF INFORMATION

Humphrey, W.S., and W.L. Sweet. *A Method for Assessing the Software Engineering Capability of Contractors*. Technical Report CMU/SEI-87-TR-23.

Pittsburgh, Pennsylvania: Software Engineering Institute, Carnegie Mellon University, 1987.

Software Process Assessment Team Members' Guide. Version 1.2. Pittsburgh, Pennsylvania: Software Engineering Institute, Carnegie Mellon University, September 1992.

B.2 PROCESS ADVISOR

R.S. Pressman & Associates, Inc., has developed a systematic approach to software engineering process improvement that is reflected in its product, Process Advisor. This multimedia product guides an organization through six technology transition cycle segments:

- **Process Assessment.** Before an organization can worry about the nuts and bolts of technology transition, it must take a hard look at current software development practices. Process assessment refers to both qualitative and quantitative information gathering that enables an organization to determine the maturity with which it develops software. To do this, a series of questions must be asked, answered, and correctly interpreted.
- **Education.** Most software managers and developers know relatively little about software engineering. To increase the level of software engineering knowledge, an organization must develop an effective education strategy that (1) is tied to the results of the process assessment, and (2) coordinates training content and timing with immediate project needs so that maximum benefit can be attained.
- **Selection.** Selection defines specific goals and criteria for selection of software engineering procedures, methods, and computer-aided software engineering (CASE) tools, and leads to the development of a rational mechanism for choosing, costing, justifying, and acquiring these important elements of software engineering technology.
- **Justification.** Expenditures for software engineering procedures, methods, education, CASE tools, and associated support activities must be shown to provide a return on investment before money is committed. A justification model is used to demonstrate the bottom-line benefits of process improvement.
- **Installation.** In order to install software engineering technologies successfully, a transition plan must be devised and then executed. The plan defines tasks, responsibilities, milestones, and deliverables, and specifies a schedule for getting the work done.
- **Evaluation.** Once managers make changes to improve the development process, select and install new technology, and then stick their heads in the sand, not spending nearly enough time evaluating whether the technology is working. The evaluation step performs an ongoing assessment of the CASE/software engineering installation process.

In the sections that follow, the first step—process assessment—is considered in more detail.

PROCESS ASSESSMENT APPROACH

The term process assessment refers to both qualitative and quantitative information gathering. When process assessment is properly conducted, it satisfies the following objectives:

- Provides a framework for an objective examination of an organization's software development practices
- Indicates technical and management strengths and weaknesses in a way that allows for comparison to industry norms
- Establishes an indication of the relative software development maturity of an organization
- Leads to a strategy for process improvement and, indirectly, to the improvement of software quality

In order to accomplish these objectives, the process assessment relies on a set of questions that inquire about an organization's process attributes. By interpreting the answers correctly, an organization takes the first step toward improving its practices.

.....

Structure

Although there are many different process assessment approaches, all have the same basic structure:

- **Assessment Questions.** The questions are designed to enable an assessor to gather enough information to gain an understanding of the software organization, the application of technology within it, and the relative sophistication of the project management framework for applying the technology. The questions are of three types: qualitative questions requiring a narrative response, boolean questions requiring a yes/no response, and quantitative questions requiring a numerical response.
- **Response Evaluation.** Responses to the questions are evaluated to determine the process maturity level by following these steps:
 - Responses to boolean questions are used to derive a maturity value.
 - Responses to quantitative questions are compared to industry averages, when available.
 - Responses to qualitative questions are used to provide additional insight into the current process.
- **Interpreting the Results.** The maturity values computed from the responses to boolean assessment questions can provide a means for developing a

transition plan for process improvement. Ideally, maturity values are assigned to one of a number of process attributes (e.g., organizational policies, project management approach, software quality assurance). Based on the maturity value, an organization can rank process attributes in order of their importance and impact on local efforts to improve process.

Once process attribute areas have been ranked, interpretation begins. Trained staff members with technology transition experience or expert outside consultants evaluate the results of the assessment and develop an organizationally specific set of findings and recommendations. Findings describe specific areas of strength or weakness and recommendations define the actions that will be required to improve the software development process.

PROCESS ADVISOR ASSESSMENT MODEL

The Process Advisor assessment model has been designed to enable self-directed assessment by those organizations that want to begin software engineering technology transition activities without incurring substantial initial expense.

Responses to the qualitative and quantitative questions are assessed using a quasi-expert system that is built into the model. Each response to the questionnaire is compared to a set of typical responses. The quasi-expert system provides a set of inferences that help an organization to develop findings and recommendations based on the response.

Boolean questions address eight process attributes:

- Organizational policies that guide the use of software engineering practices
- Training that supports the use of procedures, methods, and tools
- Framework (procedural model) that has been established to define a software engineering process
- QA activities for software
- Project management tasks that plan, control, and monitor software work
- Software engineering methods and techniques that enable technical staff to build high-quality applications
- CASE tools that support the methods
- Software metrics and measurement that provide insight into the process and its product

Responses to the boolean questionnaire portion of the Process Advisor model generate process attribute "grades" for each of the eight attributes, as shown in Table B-1.

Table B-1. Grade Interpretation for Each Process Attribute

Grade Range	Identifier	Description
Below 1.65	E	Rudimentary practice: Common in even the most undisciplined organization
1.65 to 2.25	D	Improved practice: Representative of those software development organizations that have begun to improve their software engineering approach
2.26 to 2.75	C	Advanced practice: A discipline and related activities that are to be found in the top 5 to 10% of all software developers
2.76 to 3.25	B	Excellent practice: The best possible approach to a particular software engineering activity, given commercially available technology
Above 3.26	A	State-of-the-art practice: Idealized practice that is currently unattainable in industry

These process attribute grades form an organization's process maturity "footprint," as shown in Figure B-4, thus providing an indication of relative strengths and weaknesses in the process attribute areas.

DEVELOPING FINDINGS AND RECOMMENDATIONS

Findings and recommendations are derived from the results of the assessment. It is sometimes difficult to interpret the assessment results,

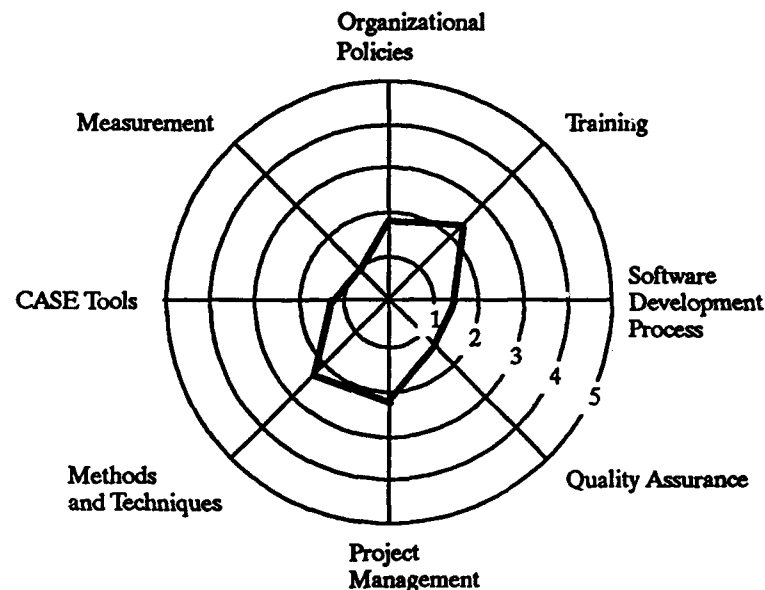


Figure B-4. Organization "Footprint"

however, in a manner that will lead to pragmatic recommendations for change. To assist in this activity, this approach provides a set of inference-based guidelines that are tied to different maturity levels for each of the process attributes under assessment. Once the assessment has been completed, the maturity grade for each process attribute is determined. The grade range provides a solid indication of both finding and recommendations.

As an example of inference-based guidelines, consider the following findings and recommendations that are reproduced from the Process Advisor Workbook:

THE SOFTWARE DEVELOPMENT PROCESS

Questions in the **Software Engineering Process** section of the process assessment questionnaire explore the emphasis on the software engineering process as it is defined for your organization. The questions focus on standards as a way to determine whether you have codified your approach. Examine your grade and place it in the context of the grade ranges in Table B-2:

Table B-2. Grade Range Mapping

Grade Range	Identifier
Below 1.65	E
1.65 to 2.25	D
2.26 to 2.75	C
2.76 to 3.25	B
Above 3.26	A

Here's how to interpret the results:

E and D: It is unlikely that you have developed a written description of your process. In fact, it is unlikely that you have defined a process in any explicit manner.

Action: Begin by creating a skeletal framework for software engineering—that is, a set of activities, deliverables, milestones and QA actions that can be applied as software is being developed. Write a description of the framework and solicit comments and recommendations from managers and technical staff. Over time, rework the framework, adding more detail, until it evolves into a standard.

C and B: Your organization has codified many of the activities associated with software development. It is likely that the same approach is applied across different projects and that project planning, control and QA are easier to achieve as a result. But a word of caution is necessary here: just because standards exist does not mean that the process is effective or properly characterized.

Action: Each of the standards should be reviewed to determine if: (1) they reflect modern software engineering practice; (2) there are aspects that can be streamlined; (3) there are aspects that just don't work very well. Time should be spent polling development staff to get their feelings on the standards and to determine whether the standards are being used as widely as these grade ranges imply. Specific technical areas without standards can be determined by reviewing responses to individual questions. It may be worthwhile to develop a framework approach for a specific technical area (e.g., testing) in a manner similar to that described in the action paragraph for E and D ranges.

ADDITIONAL SOURCES OF INFORMATION

Pressman, Roger S. *A Manager's Guide to Software Engineering*. New York, New York: McGraw-Hill, 1993.

Process Advisor Tool:
R.S. Pressman & Associates, Inc.
620 East Slope Drive
Orange, CT 06477
(203) 795-5044

B.3 ISO 9000

This description provides an overview of the ISO 9000 standards, their application to software, and an overview of a framework against which to conduct an audit of your processes against ISO 9000. For more detail on ISO 9000 and how to apply it to your own processes, refer to Section , Additional Sources of Information.

.....

OVERVIEW OF ISO 9000

ISO 9000 is a family of standards that covers the requirements for quality management systems (QMS) for manufactured products and services. Quality is defined as the totality of features or characteristics of a product or service that bear on its ability to satisfy stated or implied needs.

The purpose of ISO 9000 is to:

- Clarify the distinctions and interrelationships among the principal quality concepts
- Provide guidelines for the selection and use of a series of international standards on quality systems that can be used for internal quality management purposes (ISO 9004) and for external QA purposes (ISO 9001, 9002, 9003)

ISO 9000 follows the principle that quality system standards provide a framework for management control. The standards lay down specific requirements, but they do not tell an organization how to structure itself, how to perform activities, how to document the system, or even what procedures to write. In addition, quality system standards such as ISO 9001 are industry independent. Because of its wide application and general approach, however, the standard requires interpretation for specific industries. For example, ISO 9000-3 is the interpretation of the ISO standard for software development.

ISO 9000 comprises a series of quality system standards models and associated guidelines. Each is introduced briefly below:

- ISO 9001, 9002, and 9003 are the models for quality system standards. ISO 9002 and ISO 9003 are subsets of ISO 9001.
 - ISO 9001 is the QA model for organizations that control their quality in the whole manufacturing process, from design/development and production to installation and servicing.
 - ISO 9002 is the QA model for organizations that control their quality only in production and installation.

- ISO 9003 is the QA model for organizations that control their quality only in final inspection and test.
- ISO 9000-2 and ISO 9000-3 provide the guidelines for how to apply ISO 9001, 9002, and 9003.
 - ISO 9000-2 is the guide to the application of ISO 9001, 9002, and 9003.
 - ISO 9000-3 provides the guidelines for the application of ISO 9001 to the development, supply, and maintenance of software.

Figure B-5 shows the relationships among the ISO 9000 standards related to software.

ISO 9001 was designed to establish and assess QMS for a variety of industries. The structure and terminology of ISO 9001, however, is more applicable to hardware manufacturing than to software development. To address this concern, ISO developed ISO 9000-3 as the standard guide for applying ISO 9001 to software development, supply, and maintenance.

To audit against ISO 9001, the TickIT scheme was set up by the United Kingdom (UK) software industry under the stewardship of the British Computer Society. TickIT is an accredited quality management certification system tailored to meet the needs of the software and information technology industries. The main objectives of TickIT are to raise awareness of what is quality and how it may be managed, and to provide a QMS certification scheme that is recognized by purchasers and users, and which commands the respect of the information technology professional.

TickIT focuses mainly on software development because of its power and flexibility, its key role in information systems, and its propensity to be the source of many problems. TickIT guidance relates to the construction and formal assessment of software quality systems for registration to the requirements of ISO 9001 through the application of ISO 9000-3 guidance.

The result of a successful ISO 9001 audit is a certificate of compliance.

PERFORMING AN ISO 9001 AUDIT FOR SOFTWARE

This description provides a summary of the TickIT certification process for assessing an organization's quality systems against the requirements of ISO 9001 through the application of ISO 9000-3.

A quality audit is defined as a systematic and independent examination to determine whether quality activities and related results comply with planned arrangements, and whether these arrangements are implemented effectively and are suitable to achieve objectives. A quality audit is not an alternative to an inspection operation; it is a fact-finding process used to

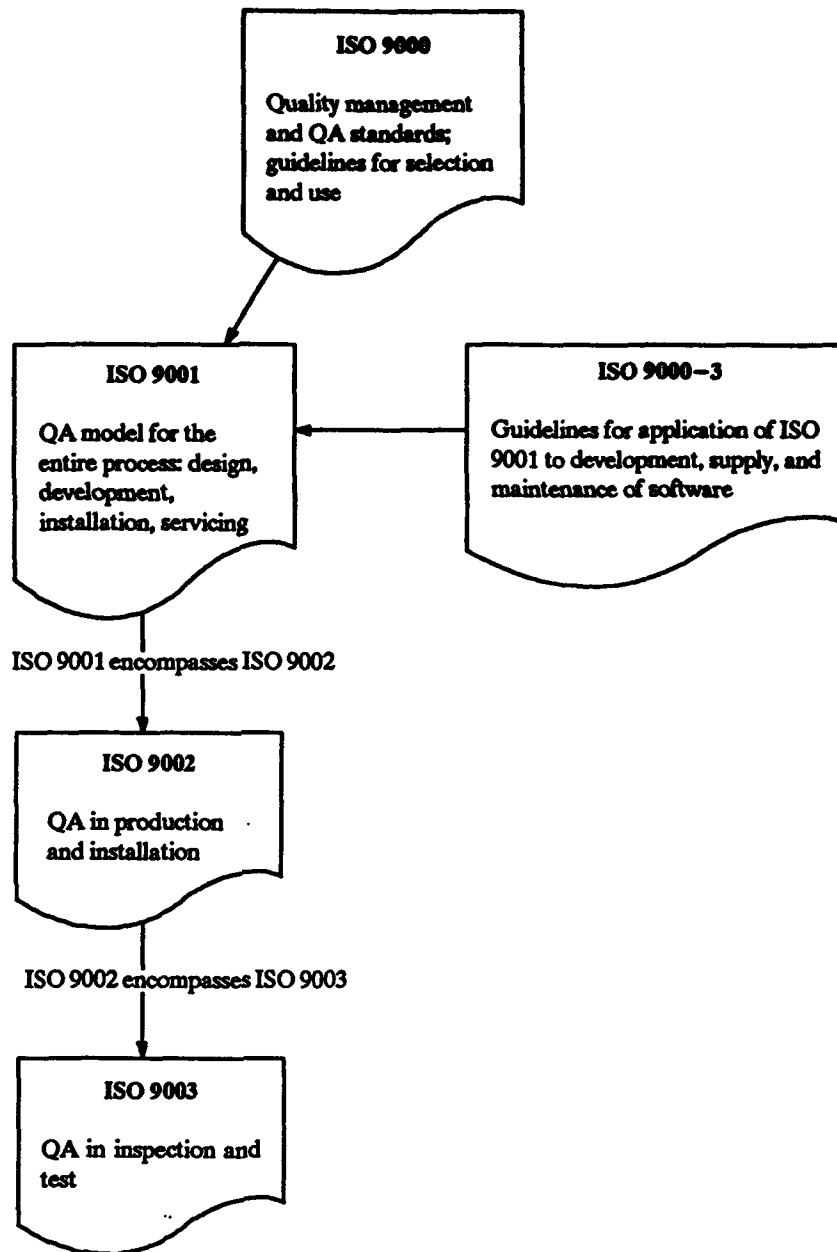


Figure B-5. ISO 9000 as Interpreted for Software

determine the suitability of and conformance to the organization's quality systems to the documented requirements.

The following lists three types of quality audits.

1. **Internal or First-Party Audit.** The audit is performed by the organization itself to determine the degree of compliance against the standard.
2. **External or Second-Party Audit.** The audit is performed by a customer or third party to determine the degree of compliance of the suppliers' quality system against the standard selected by the customer or third-party.

3. ***Extrinsic or Third-Party Audit.*** The audit is performed by an external, impartial body or regulatory authority to determine the degree of compliance against the standard. The external, impartial body must be accredited by a recognized national accreditation authority if the organization is to receive a certificate of compliance.

This method uses the following role definitions: The auditor is the person or group possessing the qualifications to perform quality audits; the auditee is the organization being audited; the auditor managing the audit is the lead auditor.

There are three phases in performing an ISO 9001 audit for software development: pre-audit, audit, and post-audit. These phases are discussed in the following sections.

.....

Pre-Audit

The pre-audit process includes the following steps. Each step provides guidance for both the auditee and the auditor, as appropriate.

- ***Scope.*** The auditee must define the scope of its organization to be audited. When drafting the scope, the auditee needs to keep the following in mind: Software development work must form part of the activities of the scoped area; the definition of the scope must broadly reflect the business functions, services, and typical products supplied to its customers; the scope must cover not just the software in isolation, but also the surrounding systems areas; and the scope should reflect any particular market niches of the organization. The objective of the auditee is for the audit to cover all aspects of the quality system within that scope. In the scope, the auditee also identifies which standards the organizations wishes to be compliant against.

The statement of scope is used by the lead auditor to plan the audit, which includes selecting projects and functions to demonstrate the audited organization's capability, estimating the duration of the audit, and selecting auditors with the appropriate background.

- ***Auditor Team.*** The auditee typically requests quotations from two or three certified auditors, based on the scope of the audit. The auditee then selects the desired auditor and issues a contract.

The members of the audit team should have technical expertise in the methods, techniques, and tools used in the auditee's organization; leadership qualities, experience in team management, and the ability to deal with difficult interpersonal relationships; and be independent of the auditee's organization (i.e., not have any current work assignments with them). Auditors who perform a third-party audit must be

certified by a national accreditation authority. Both the size of the team and the time needed for the audit depend on the scope of the audit, the number of locations to be audited, and the organization's complexity. An audit of a small organization can be conducted by one person; a major audit of a large organization should be conducted by several auditors.

- **Pre-Audit Information.** The auditee provides information about its company to the auditors so they can adequately prepare for the audit. The needed information is usually included in the auditee's quality manual, a requirement of the quality systems standard. Other information the auditee provides includes policies and procedures, marketing information, organizational structures, and any other information that can offer insight into the business and activities of the auditee's organization.

The lead auditor requests in detail the information needed. After receiving the information, the lead auditor evaluates the content of the documentation against the quality system standard and proposed scope.

- **Preliminary Auditor Visit.** The auditors may visit the auditee organization prior to the audit and review the auditee's quality management systems. This may be necessary if the information provided in the previous step did not provide enough information for the auditor to adequately plan for the audit. The preliminary visit can offer the following benefits: The auditor can make sure the auditee completely understands the audit process; the auditor can notify the auditee of any significant omissions or deviations from the ISO 9001 requirements that need to be addressed prior to the audit; and the auditor has the opportunity to review as much of the documented quality system as possible before the audit.
- **Audit Program.** It is impossible for an auditor to investigate all of the quality activities within an organization during one audit period. Therefore, the auditor makes sure the team looks at a representative sample of activities or evidence. By defining ahead of time the areas to be audited, and knowing how much time is allocated for the audit, the auditors can plan and prepare how the audit will be conducted. The audit program includes:
 - Location to be audited
 - Purpose and scope of the audit
 - Dates, including starting time for the opening meeting and starting time for the closing meeting

- Timed program of visits
- Names of the audit team members

The auditor forwards the audit program to the auditee before the audit so that the auditee can make the necessary arrangements. Negotiations often take place between the auditor and the auditee on the final program.

The auditors also indicate the extent of coverage of the ISO 9001 standard that will be achieved by the audit program, detailing the coverage by area within the auditee's organization if possible.

- **Audit Team Briefing.** If there are more than two auditors, the lead auditor holds an audit team meeting to review the scope and objectives of the audit, plan preparation of checklists (see next step), and share any information.
- **Checklists.** The auditor develops checklists to be used to audit each area of the auditee's organization. These checklists should be developed by the entire audit team. They provide a well-balanced, well-paced structure to the audit, and are especially beneficial if auditors are reassigned from area to another.

In preparing the checklists, the auditors define which quality system standards will be audited in each work area. Guidance for preparing checklists include:

- The auditors should be fully knowledgeable of the objectives and scope of the audit and the ISO 9001 standard.
- A minimum of one checklist per work area being audited should be used.
- The number of items on the checklist depends on the complexity of the audit and the amount of time available for the audit of that work area.
- The amount of detail needed in a checklist is at the discretion of the auditor performing that part of the audit.
- The auditor should not be afraid to stray away from the checklist if information arises that will provide insight into that work area's quality system practices. The auditor must ensure, however, that enough time remains to cover all checklist items.

From the initial decision to audit the organization throughout the audit, the auditee must ensure that the organization is aware of the forthcoming audit, review all projects and groups prior to the audit, prepare a list of all projects currently active, ensuring that all different types of projects identified in the

scope are clearly identified; and ensure that the administrative needs of the auditor (e.g., work space) are met.

.....

Audit

The audit process includes the following steps:

- **Start-Up Meeting.** The start-up meeting is chaired by the lead auditor. The auditee organization's management must attend to show the organization's commitment to the audit. In this meeting, the objectives and scope of the audit are explained to the auditee organization's management, all arrangements are confirmed, responsibilities for the audit are confirmed (see next step), the general rules of the audit are established, the audit process is reviewed, and auditee questions are answered.
- **Audit Responsibilities.** Auditing groups are formed to conduct the audit. There may be one or more groups, depending on the number of auditors. Each auditing group should consist of the auditor(s), a guide from the auditee organization, a manager from the area being visited, and other observers witnessing the audit. Each role is described briefly below:
 - The auditor is responsible for auditing the assigned area of the auditee's organization.
 - The guide escorts the auditors from one department to another and introduces them to the involved staff of the area being audited.
 - The manager answers any questions and provides any information in support of the audit.
 - Observers learn from, but do not take part in, the audit.
- **Perform Audit.** The auditor performs an in-depth appraisal of the auditee's procedures and the overall management structure for compliance with ISO 9001, using applicable guidance material from ISO 9000-3. The auditor looks at a representative sample of projects to perform the audit.

The auditors compare the auditee's organization quality manual and standards to ISO 9001, using the checklists to discover any nonconformities. The auditee representative is asked to confirm any nonconformity. The auditor is responsible for identifying and justifying any nonconformities that are found.

Before the closing meeting, the lead auditor meets with the auditors and collects all of the nonconformities. The audit team decides which

nonconformities to combine, ignore, or declare as a nonconformity, and the lead auditor decides which of the nonconformities to declare as a major or minor nonconformity. A major nonconformity occurs when there is an absence and/or breakdown of a quality system element. A minor nonconformity occurs when there is an occasional instance of failure in a quality system element.

The lead auditor then prepares a summary statement, the auditors prepare a nonconformity statement, and, optionally, the full report is prepared.

- **Closing Meeting.** The closing meeting is the climax of the entire audit. At the closing meeting, the lead auditor restates the audit process that was followed, stressing the fact that only a sample of the auditee's organization was visited, and then presents the summary report and the noncompliance statement. The auditee representative signs acknowledgment of the nonconformities. The closing meeting is chaired by the lead auditor.

If the audit was done by a third party, then recommendations for certification are not made at the closing meeting. For second-party auditors, recommendations are announced at the closing meeting only if this is agreed to by both parties. First-party audits usually present the recommendations for certification at the closing meeting.

The organization uses the closing meeting to start the next cycle of improvement, based on the findings of the audit.

.....

Post-Audit

If a certificate of compliance was awarded, then a third-party certification body will make regular surveillance visits, typically twice a year, to ensure that the company is still following the agreed practices.

In order to retain its certification and maintain quality, an organization must continually improve its documented quality system.

ADDITIONAL SOURCES OF INFORMATION

International Organization for Standardization, *ISO 9000-3*, 1st ed., 1991-06-01, Geneva, Switzerland, 1991.

TickIT Project Office, *Guide to Software Quality Management System Construction and Certification*, EN 29001/BS 5750 Part 1 (1987), Issue 2.0, (London, England: TickIT Project Office, 1992).

Excel Partnership, Inc., and Georgia Institute of Technology Center for International Standards and Quality, *ISO 9000 Software Lead Auditor* (course taught in Atlanta, Georgia, 10-14 May 1993).

Registrar Accreditation Board, *Guide to Software Quality System Construction and Registration*, Issue 0.1, Milwaukee, Wisconsin: Registrar Accreditation Board, 1993.

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APPENDIX C. ASSESSMENT FINDINGS PRESENTATION OUTLINE

Appendix Objective

***Provide an outline for
structuring a findings
presentation***

This appendix provides an annotated outline for presenting the final findings from an assessment, along with an example presentation.

C.1 PRESENTATION CONTENT

This section provides an outline of the presentation, with comments on the general content of each potential slide. Text in triangular brackets denotes instructions for placement of text or graphics.

TITLE

The text or graphics may be unique to your organization or reference specific parts of this guidebook.

Set the context of this briefing to focus on the findings derived from the assessment.

AGENDA

List the topics that are to be discussed during this presentation.

ASSESSMENT TIMETABLE

List the key activities conducted during the assessment and when they occurred.

SCOPE OF THE ASSESSMENT

Present the following attributes of the assessment:

- Type of assessment performed
- List of projects representing the organization
- Functional areas covered

- Number of assessment team members
- Total number of participants from the organization

ASSESSMENT PROCESS FLOW

Describe the basic flow of the assessment.

ORGANIZATION'S COMPOSITE STATUS

If a numerical rating was established, present it here. You may also want to give an impression of the findings, such as "numerous policies, standards, and guidelines exist, but are not consistently applied." Alternatively, depending upon your organization's culture, you may want to present this information at the end.

STRENGTHS

List the major organizational strengths that exist.

FINDINGS

List all the major findings categories that are to be presented.

NAME OF FIRST FINDINGS CATEGORY

Finding(s)

- List a finding in this category.
 - Include a list of any observations that support this finding.
- List any other findings in this category.
 - Include a list of any observations that support these findings.

Consequences

- List an undesirable consequence of these findings.
- List any other undesirable consequences of these findings.

NAME OF FINDINGS CATEGORY N

Repeat the information for each findings category.

NEXT STEPS

Present a list of activities that the organization should perform to improve the organization's practices.

C.2 EXAMPLE FINDINGS PRESENTATION

An example based on the above outline is shown.

ABC Corporate Division

Software Process Assessment
Findings Briefing

December 11, 1993

Agenda

- Assessment Background
- Composite Status
- Strengths
- Findings
- Next Steps

Assessment Timetable

- | | |
|------------------------------------|-----------|
| • Assessment Team Training | 28–30 Oct |
| • Assessment Participants Briefing | 23–24 Nov |
| • On-site Assessment | 7–11 Dec |
| • Recommendations Presentation | TBD |
| • Action Plan Review | TBD |
| • Reassessment | TBD |

Scope of the Assessment

- Assessment followed the SEI-prescribed process
- 5 representative projects:
<list representative projects here>
- 35 representatives from the following areas:
<list functional areas>
- 11 assessment team members

Assessment Process Flow

<insert Figure B-3 here>

SEI Process Maturity Levels

<insert Figure B-1 here>

Composite Status

- ABC Corporate Division is at the Initial level of software process maturity.

Strengths

- People with "can do" attitude
- Commitment to customer support
- Diverse workforce
- Flexibility and adaptability

Findings

- Project Planning and Estimating
- <list additional findings categories here>

Project Planning and Estimating

Findings

- Planning inadequate to cover software activities and commitments appropriately
 - <list observations here>
- Insufficient staff and schedule allocated to project
 - <list observations here>

Consequences

- Product quality reduced
- <list other consequences here>

Findings Category N

Findings

- <list finding here>
 - <list observations here>
- <list finding here>
 - <list observations here>

Consequences

- <list consequence here>
- <list other consequences here>

Next Steps

- Risk Analysis
- Action Plan
- Action Plan Briefing
- Action Plan Implementation
- Reassessment

APPENDIX D. ASSESSMENT FINDINGS AND RECOMMENDATIONS REPORT TEMPLATE

Appendix Objective

***Provide a template
for a findings and
recommendations
report***

This appendix provides you with an annotated template for your findings and recommendations report.

As with any well-written report, this report should have a title page and table of contents, though this template does not show them.

D.1 EXECUTIVE SUMMARY

The executive summary serves as a synopsis of the report. A reader should be able to get a general idea of the findings from an assessment and of the recommendations made by the assessment team and PG by reading this summary. Everything discussed in the executive summary should be covered in the document in more detail. The executive summary should be the last part of the report you write. If you do a good job on the other sections, you can develop a first draft of the executive summary by rephrasing paragraphs from the rest of the report.

INTRODUCTION

Discuss briefly the events that led to an assessment and the assessment itself.

Include an overview of the contents of this report.

NAME OF FIRST FINDINGS CATEGORY

Discuss the major finding that was derived from the assessment and the recommendations for improvement that were proposed. This section should be kept to one concise paragraph. The titles of these sections should correspond exactly to the findings categories presented in the findings presentation.

NAME OF FINDINGS CATEGORY N

Repeat this section for each major findings category.

NEXT STEPS

Discuss briefly the next steps that you feel should be taken to begin implementing the recommendations.

D.2 ORGANIZATION PROCESS STATUS

Discuss the maturity of your organization's processes. If a numerical rating was established, present it here. Give a high-level impression of the findings, such as "numerous policies, standards, and guidelines exist, but are not consistently applied."

If any projects exhibit good practices, mention those practices. Do not identify any projects specifically.

Include a brief discussion on the organization's strengths.

D.3 KEY FINDINGS AND RECOMMENDATIONS

In this section you identify the key findings and associated recommendations. Provide a list of the findings that you discuss.

NAME OF FIRST FINDINGS CATEGORY

Introduction

Provide an overview of the findings category.

Finding(s)

Present the finding(s) in this category, exactly as presented in the findings presentation:

- State the finding in general terms.
 - State specific observations that support this finding.
- State any other findings in general terms.
 - State specific observations that support these findings.

Discussion

Discuss the finding(s) in greater detail.

Consequences

Discuss the consequences the organization is experiencing due to the observations supporting the findings category.

Recommendation(s)

Present the recommendations to improve the practices in this findings category that the organization should implement:

- State the first recommendation
- State the nth recommendation

Recommendations stated in bullet form are used directly in the findings and recommendations presentation.

Discussion

Discuss in greater detail the recommendations made and the positive consequences the organization should experience.

NAME OF FINDINGS CATEGORY N

Repeat Section for each major findings category.

D.4 NEXT STEPS

In this section you introduce the five to seven activities that the organization should perform to improve the organization's practices. Typically, these steps are steps from the process improvement process (i.e., Analyze Risks and Select Strategy, Plan Improvements, Implement Improvements, Review and Update, and Understand Context). After completing these steps, the organization should be prepared to reassess the organization's practices.

NAME OF FIRST STEP

Describe briefly the activities to be performed within this step and why this step is important.

NAME OF NTH STEP

Describe briefly the activities to be performed within this step and why this step is important.

D.5 APPENDIX: CONDUCTING THE ASSESSMENT

This appendix provides the reader with an overview of the assessment activities performed, the lessons learned, and the projects and functional areas assessed.

D.6 GLOSSARY

Provide a glossary of key words found in the report.

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APPENDIX E. ASSESSMENT FINDINGS AND RECOMMENDATIONS PRESENTATION OUTLINE

Appendix Objective

*Provide an outline for a
findings and
recommendations
presentation*

This appendix provides you with an annotated outline for presenting the recommendations from an assessment to all those involved in both the assessment and the process improvement program in general. This information is taken directly from the findings and recommendations report, outlined in Appendix D. An example presentation is also included.

E.1 PRESENTATION CONTENT

This section provides an outline of the presentation, with comments on the general content of each potential slide.

TITLE

Set the context of this briefing to focus on the recommendations derived from the assessment.

AGENDA

List the topics that are to be discussed during this presentation.

ASSESSMENT TIMETABLE

List the key activities conducted during the assessment and when they occurred.

SCOPE OF THE ASSESSMENT

Present the following attributes of the assessment:

- Type of assessment performed
- List of projects representing the organization
- Functional areas covered

- Number of assessment team members
- Total number of participants from the organization

ASSESSMENT PROCESS FLOW

Describe the basic flow of the assessment.

ORGANIZATION'S COMPOSITE STATUS

If a numerical rating was established, present it here. You may also want to give a high-level impression of the findings, such as "numerous policies, standards, and guidelines exist, but are not consistently applied."

FINDINGS AND RECOMMENDATIONS

List all the major findings categories that are to be presented.

NAME OF FIRST FINDINGS CATEGORY

The findings and consequences should come directly from the findings presentation.

FINDING(S)

- List a finding in this category.
 - Include a list of any observations that support this finding.
- List any other findings in this category.
 - Include a list of any observations that support these findings.

Consequences

- List a consequence of these findings.
- List any other consequences of these findings.

NAME OF FIRST FINDINGS CATEGORY (CONTINUED)

The recommendations should come directly from the findings and recommendations report.

Recommendation(s)

- List a recommendation to improve the practices in this category.
 - List any supporting information.
- List any other recommendations to improve the practices in this category.
 - List any supporting information.

NAME OF FINDINGS CATEGORY N

Repeat the two previous slides/charts for each findings category.

NEXT STEPS

Present a list of activities that the organization should perform to improve the organization's practices.

E.2 EXAMPLE FINDINGS AND RECOMMENDATIONS PRESENTATION

An example based on the above outline is shown.

ABC Corporate Division
Software Process Assessment
Findings and Recommendations
Briefing

January 29, 1994

Agenda

- Assessment Background
- Composite Status
- Strengths
- Findings and Recommendations
- Next Steps

Assessment Timetable

- | | |
|------------------------------------|-----------|
| • Assessment Team Training | 28–30 Oct |
| • Assessment Participants Briefing | 23–24 Nov |
| • On-site Assessment | 7–11 Dec |
| • Recommendations Presentation | 29 Jan |
| • Action Plan Review | TBD |
| • Reassessment | TBD |

Scope of the Assessment

- Assessment followed the SEI-prescribed process
- 5 representative projects:
 <list representative projects here>
- 35 representatives from the following areas:
 <list functional areas>
- 11 assessment team members

Assessment Process Flow

<insert Figure B-3 here>

SEI Process Maturity Levels

<insert Figure B-1 here>

Composite Status

- ABC Corporate Division is at the Initial level of software process maturity.

Strengths

- People with "can do" attitude
- Commitment to customer support
- Diverse workforce
- Flexibility and adaptability

Findings and Recommendations

- Project Planning and Estimating
- <list additional findings categories here>

Project Planning and Estimating

Findings

- Planning inadequate to cover software activities and commitments appropriately
 - <list observations here>
- Insufficient staff and schedule allocated to project
 - <list observations here>

Consequences

- Product quality reduced
- <list other consequences here>

Project Planning and Estimating

Recommendations

- Develop, disseminate, and enforce a consistent planning and estimating process
 - <list subrecommendations here>
- <list additional recommendations here>

Findings Category N

Findings

- <list finding here>
 - <list observations here>
- <list finding here>
 - <list observations here>

Consequences

- <list consequence here>
- <list other consequences here>

Findings Category N

Recommendations

- <list recommendation here>
 - <list subrecommendations here>
- <list additional recommendations here>

Next Steps

- Risk Analysis
- Action Plan
- Action Plan Briefing
- Action Plan Implementation
- Reassessment

APPENDIX F. RISK MANAGEMENT PLAN TEMPLATE

Appendix Objective

***Provide a template for a
risk management plan***

The purpose of this plan is to capture the risks, their probability and impact, and the plan to manage them, as identified during the risk assessment. This document captures which techniques and methods the manager is using to identify, analyze, and mitigate the risks. It also provides a place to collect and organize all information concerning the project's risks that is necessary to present to senior management.

Once the risk management plan is developed, the plan will continue to be updated with information concerning whether the identified risk has occurred, the effect of the risk mitigation strategy planned for the risk, and any other risk-related information that would be useful in future risk analysis.

Tailor this plan to capture the essential characteristics of the project's environment. Focus on understanding what you absolutely must do, what you should not do, and what you may do if appropriate.

The risk management plan will be reviewed and updated, as required, during the course of the project. Section F3, Analysis of Spiral Risk at Cycle N, will be repeated in its entirety for each cycle.

F1 PURPOSE AND SCOPE

In this section, document the purpose and scope of the risk management plan in terms of the objectives. Outline who is responsible for which portions of the risk management plan, and who are to be the performers of the risk mitigation strategies. Document any assumptions or constraints that the risk management plan is working under.

F2 SELECTED RISK MANAGEMENT METHOD

This section documents and describes the selected risk management techniques to be used. Identify which technique has been selected to measure the probability of a risk, measure the impact of a risk, and measure the combined probability and impact. Also include how risks are to be measured over time.

Once a specific risk management technique is selected, it should remain in place for the duration of the project, so that the risk values can be

recalculated after specific risk mitigation strategies have been applied. Using the same risk analyst and same method will aid with tracking risks over time.

E3 ANALYSIS OF SPIRAL RISK AT CYCLE N

This section is cycle specific and may be repeated in its entirety for each subsequent cycle.

OVERVIEW

The purpose of this section is to capture an overview of the cycle and what is trying to be accomplished in that cycle. Document the cycle objectives, assumptions, and constraints. List any items being referenced.

RISK IDENTIFICATION

Document the specific risks within the following categories:

- **Organizational Risks.** These risks involve the aspects of the different approaches and capabilities that an organization can bring to a system development effort.
- **Process Risks.** These risks involve the aspects of system engineering approaches used to develop products.
- **Product Risks.** These risks are inherent within the software-intensive system itself.

In this section you document the risks and map each risk to goals, objectives, alternatives, and constraints. If appropriate, document known triggers for a risk and the potential damage for each risk item. Also include the amount of risk that is acceptable for each individual risk and the acceptable level of overall spiral risk. Document references for the sources of risk.

RISK ANALYSIS

In this section, you document a list of high-priority risk items. For each of these risks document the following information:

- Risk description
- Cause
- Consequence of occurrence
- Probability of occurrence

- Frequency of occurrence
- Risk factor
- Time
- Coupling/compounding risk

Also include any additional information necessary to support the analysis.

RISK EVALUATION

For each high-priority risk, document the identified risk mitigation strategy. The following information should be included:

- Identification, ranking, and analysis of alternative strategies for mitigating the high-priority risks
- Identification of any new risks associated with the identified alternative strategies

RISK MITIGATION

Document each risk mitigation strategy that has been identified. Include a description of each mitigation strategy, the specific risk(s) that you will mitigate, a WBS that lists the individual tasks that you need to accomplish, constraints, guidance, an estimate of how long it will take to complete each task, when the task is to begin, an estimate of the resources required, plans for monitoring the risk mitigation activities, products to be produced, and the criteria for success (i.e., when you will consider the risk[s] to be averted).

RESULTS

At the completion of a mitigation strategy, document the impact that the technique had on each risk that it affected. Document cost and schedule metrics for the mitigation strategy, and note how the risk mitigation strategy was executed. Identify and document the new probability, consequence, and frequency of occurrence of the affected risks.

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APPENDIX G. ACTION PLAN TEMPLATE

Appendix Objective

Provide a template for an action plan

This appendix provides you with a template for an action plan. Refer to Section 6.1, Define/Update Action Plan, for a complete discussion on the action plan, including logical structure, contents, and planning tasks. (The action plan template in this appendix does not correspond directly to the illustration presented in Figure 6-2.)

The action plan may be structured according to your needs. The plan presented here is hierarchical in nature, but the numbering scheme and page numbers must be changed to reflect a stand-alone document. You may wish to include a title page and table of contents.

G.1 EXECUTIVE SUMMARY

The executive summary serves as a synopsis of the entire action plan. A reader should be able to get a general idea of the motivation, approach, schedule, staffing, and risks associated with the process improvement effort by reading this summary. Everything discussed in the executive summary should be covered in the document in more detail. The executive summary should be the last part of the plan you write. If you do a good job on the other sections, you can develop a first draft of the executive summary by rephrasing paragraphs from the rest of the action plan.

EVENTS LEADING TO ACTION PLAN

Establish a historical context for the action plan. Conduct the following:

- Discuss the events that led to the decision to conduct an assessment.
- Review briefly the steps of the assessment that led to the findings and recommendations report.
- Discuss the steps taken to write the action plan.

PURPOSE OF ACTION PLAN

The purpose of an action plan is to implement the improvements identified in the findings and recommendations report. This section discusses, in general terms, how the action plan supports the findings and recommendations report and relevant corporate objectives.

MAJOR RECOMMENDATIONS AND INITIAL ACTIONS

Introduce the major recommendations from the findings and recommendations report, and discuss the first improvement actions that will be taken. The purpose of this section is to inform the reader of what comes next, specifically:

- Actions to be implemented first
- Actions that will produce the most-needed improvement

CRITERIA FOR SUCCESS

In general terms, discuss how you will evaluate the success of implementation of this action plan. This section should be a summary of the milestones and evaluation section of the appendix on new technologies and procedures, found in Section G.7.

SUMMARY OF SCHEDULE

Discuss the major milestones of the schedule. This section should be a summary of the information discussed in Section . Be sure to discuss several near-term milestones. This section should convince the reader that there will be a steady stream of benefits, rather than a long period of work with no visible payoff.

G.2 INTRODUCTION

The purpose of the first two sections of the introduction is to convince the reader that the action plan is worth implementing. The remaining five sections introduce and summarize concerns that are addressed in detail in later sections of the plan. Each of the remaining sections should indicate where the reader can find more detailed information.

INITIATIVE TO IMPROVE

Briefly discuss the reason(s) your organization needs to improve its software process.

BENEFITS

Discuss the benefits you expect to result from your process improvement effort. Indicate how your organization's corporate objectives are to be served by implementing the actions in this plan.

ACTIONS

Summarize the key process areas that are addressed by the action plan and the most important actions in each area.

ACTION PLAN MANAGEMENT

Discuss your overall strategy for funding, staffing, and scheduling the process improvement effort. You can refer the reader to the section on Action Plan Management, Section G.4.

RISK ANALYSIS

Summarize your approach to risk analysis, the major risks you identified, and the way you plan to address them. Briefly state the constraints you must live with and how these constraints impose risks.

PROCESS ACTION TEAMS

Name and summarize the purpose of each PAT.

NEW TECHNOLOGIES AND PROCEDURES

Briefly discuss the major new technologies and procedures that are to be adopted under this plan. It is not necessary to mention every addition, but you should say something about the new technologies and procedures that are:

- Most beneficial
- Most prone to risk
- Most challenging to implement

G.3 ACTIONS

This section defines your responses to the assessment team's findings and recommendations. This section should convince the reader that each recommendation has been considered during the action planning process, that the response to each recommendation is reasonable, and that the new technologies and procedures to be introduced will not adversely impact ongoing projects.

RECOMMENDATIONS AND RESPONSES

In this section, you organize recommendations by process area and discuss the response to each recommendation. Mention every recommendation in the findings and recommendations report. If you decided not to implement a recommendation, justify the decision in the associated response.

NAME OF FIRST PROCESS AREA

Include one section for each process area that is mentioned in the findings and recommendations report or that is addressed by this action plan.

If a recommendation applies to several process areas, include it in the most appropriate area. Do not discuss a recommendation more than once. Use a format similar to the following:

- **Recommendation.** Summarize briefly a recommendation or a group of recommendations that have a common response.
- **Response.** Describe the response to the recommendation in the previous paragraph. In most cases, the response will involve implementing one or more of the new technologies or procedures described in Appendix B in Section G.7. Note that several actions can be associated with a particular new technology or procedure. For example, introduction of a new software design tool involves purchasing the tool, installing it on one or more platforms, training engineers in its use, establishing a mechanism for resolving problems, and introducing the tool to existing projects. Describe each action separately since you may allocate actions for a single new technology or procedure to more than one PAT. Show how each action supports corporate initiatives.

If you choose not to follow a recommendation, explain why.

- **Recommendation.** Repeat this paragraph for each recommendation in the process area.
- **Response.** Repeat the response for each recommendation.

NAME OF SECOND PROCESS AREA

Repeat this section for each process area addressed by this action plan.

TRANSITION TO PROJECTS

Process improvement involves acquiring new technology, adding new procedures to your software development process, and modifying procedures that are already in place. Often, new technologies and procedures must be tailored for existing projects. In this section, you discuss the impact you expect new technology and procedures to have on existing projects and summarize guidelines for tailoring them for ongoing projects. Include detailed tailoring instructions with the technology and procedure descriptions in Appendix B, found in Section G.7.

EXPECTED IMPACT ON EXISTING PROJECTS

Explain how new technologies and procedures are expected to impact existing projects.

GUIDELINES FOR INTEGRATING WITH EXISTING PROJECTS

Summarize guidelines for tailoring procedures and adapting new technology for existing projects. The adaptation should involve additional actions beyond those described in Section . List the additional actions in this section.

G.4 ACTION PLAN MANAGEMENT

The purpose of this section is to identify the PATs that carry out the process improvement actions, the funding allocated to each group, and the schedule.

APPROACH

Introduce and justify your approach to managing process improvement.

WORK BREAKDOWN STRUCTURE

The WBS is a hierarchical decomposition of a process improvement task into increasingly detailed subtasks. This section should include a diagram of the tasks and subtasks and a brief (one line) description of each. Link each task and subtask back to the actions discussed in Section .

ORGANIZING FOR PROCESS IMPROVEMENT

In this section, you introduce the groups that are to implement the action plan. Name and describe briefly each PAT. Provide detailed descriptions in Appendix A, found in Section G.6.

Include an organization chart that shows reporting responsibilities and other interactions among groups. The PG should oversee the entire effort.

RESPONSIBILITY MATRIX (RESOURCE ALLOCATION)

In this section, you allocate the actions described in Section to the PATs introduced in Section . Specify who is to implement each action and who is to evaluate its implementation. In many cases, you will allocate different actions for the same improvement to several teams.

Consider using a matrix to map actions to teams.

BUDGET

Describe the source and amount of funding for each of the working groups introduced in Section .

SCHEDULE

The schedule should show the planned starting and ending times for each action described in Sections and , as well as dependencies between actions. If possible, it should also show when each action will impact each project. Consider using a Program Evaluation and Review Technique or Gantt chart to represent the schedule. Remember that the process improvement effort should produce a steady stream of visible results; you must have short-term and long-term milestones in order to ensure continued buy-in.

CRITERIA FOR SUCCESS

In this section, you discuss how you will measure success both while the action plan is being implemented and after all actions are in place.

For each process area, track success at least to the level of goals. You may track success to the level of individual practices, or to an even finer level of detail, if you choose.

G.5 RISK ANALYSIS

In general, the objective of risk analysis is to develop an understanding of possible impediments to process improvement and to decide how you will deal with those impediments if they arise. In this section, refer to the risk management plan. You may choose to provide an overview of key risks and mitigation strategies here.

G.6 APPENDIX A: PROCESS GROUP AND PROCESS ACTION TEAM CHARTERS

In this section, provide a detailed description of each group involved in implementing this action plan. Be sure to include any existing groups, such as the PG. Some groups, such as temporary investigative committees, may be too informal to include in this appendix.

NAME OF FIRST GROUP

For each group, describe its mission (purpose), life span (length of existence), responsibilities, positions for individuals within the group, the individuals above and below the group in the chain of command, and any other individuals or groups with which the group will interact. Also list the members of the group.

MISSION STATEMENT

Briefly describe the purpose of the group.

LIFE SPAN

Certain groups, such as those devoted to adapting new technology and procedures to existing projects, may have a limited life span. Indicate in this section how long each group is expected to operate. If possible, tie temporary groups to a pair of milestones: one for the point at which the group begins to function, and the other for the point at which the group disbands.

DETAILED GROUP RESPONSIBILITIES

Use a list to describe, in detail, the responsibilities of the group.

POSITIONS WITHIN GROUP

Name and describe the responsibilities of each unique position within the group. Examples of positions include group leader, technologist, and technical writer.

MEMBERS OF GROUP

List the name and position of each member of the group. For each, indicate how they can be contacted, what percentage of their time they will allocate to the group, and how long they will be members.

SUPERVISING INDIVIDUALS OR GROUPS

List the individuals or groups above this group in the chain of command.

SUBORDINATE GROUPS

List the groups below this group in the chain of command.

INTERACTIONS WITH OTHER GROUPS

List groups (other than superior or subordinate groups) with which this group is to interact on a regular basis. Describe the nature of the interaction.

NAME OF SECOND GROUP

Repeat this section for each group involved in implementing this action plan.

G.7 APPENDIX B: NEW TECHNOLOGIES AND PROCEDURES

In this section, describe each new technology or procedure, justify its adoption, discuss what other technologies and procedures must be in place for it to work, list the skills required to use it, and discuss how it can be tailored for use on specific projects.

The information requested can be obtained performing technology transfer activities discussed in *Using New Technologies: A Technology Transfer Guidebook* (Software Productivity Consortium 1993e), specifically by executing Cycles 1 and 2 of the technology transfer process.

NAME OF FIRST NEW TECHNOLOGY OR PROCEDURE

Describe the new technology or procedure and include a list of reference material and sources of expertise.

REASON FOR ADOPTION

Explain why your organization is adopting the new technology or procedure. Tie the technology or procedure to the actions described in Section .

ENABLING TECHNOLOGIES OR PROCEDURES

Describe any technologies or procedures that must be in place in order for this technology or procedure to work.

SKILLS AND TRAINING REQUIRED

Describe skills and/or training needed by users of the technology or procedure.

TAILORING APPROACH

The tailoring approach for a specific technology or procedure consists of general guidelines (i.e., what can be changed and what must be left alone) and detailed plans for tailoring the technology or procedure to specific projects. Obviously, plans for tailoring to specific projects should not contradict the general guidelines.

General Guidelines

Describe, in general terms, how this technology or procedure can be tailored for use on existing and new projects. In general, new technologies and procedures should be applicable to new projects without tailoring. Tailoring may be necessary for existing projects and for future projects, however, when mandated by the customer. Your description should

indicate what aspects of the technology or procedure might change and what aspects must be the same for any application. For aspects that might change, include a list of alternatives.

Tailoring for Specific Projects

Indicate how you will adapt the technology or procedure to each existing project. If you know of new projects that will require tailoring, discuss them in this section as well.

MILESTONES AND EVALUATION

Discuss how your organization will know that the technology or procedure has been successfully adopted.

NAME OF SECOND NEW TECHNOLOGY OR PROCEDURE

Repeat Section for each new technology or procedure.

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APPENDIX H. MEASURING PROCESS IMPROVEMENT

Section Objective

Provide guidance on how to measure process improvement

This appendix addresses what to measure, when to measure, and how to measure to determine and verify process improvement. This appendix describes the relationship between measurement practices and process maturity, the Goal-Question-Metric (GQM) method, and suggested process, product, and management measurements.

The GQM method uses the following definitions for measurement and metric:

- A measurement is a number assigned to a directly observable aspect of a process or product.
- A metric is a function of one or more measurements. A metric may be directly observable or may be derived through a calculation involving one or more metrics and measurements.

Refer to the *Software Measurement Guidebook* (Software Productivity Consortium 1992b) for more information on establishing a measurement program.

H.1 MEASUREMENT AND PROCESS MATURITY

As a software development organization matures, it experiences an increasing level of software process measurement activity. This section discusses the organization's visibility into the software process that exists at various levels of process maturity.

SOFTWARE MEASUREMENT AT LOWER MATURITY LEVELS

A software organization operating at a low maturity level measures little of its software process. There is no reliable way either to assess the status of the product under development or to assess the effectiveness of the development process. A process in this state of maturity can be represented by the open loop control system in Figure H-1. An open loop control system is characterized by an input to establish the process goals and product requirements, the process, and an output product that may or may not meet its requirements. The noise represents variability in the

requirements and estimates that are the bases of the process goals. Establishment of the process goals depends on the skill and experience of the project management. Any corrective action, required due to noncompliance of the product to its requirements, depends on the skill of management and technical staff, rather than actual information about the process and product. The lack of measurement data precludes the use of actual experience to adjust the process for performance variances from the goals.

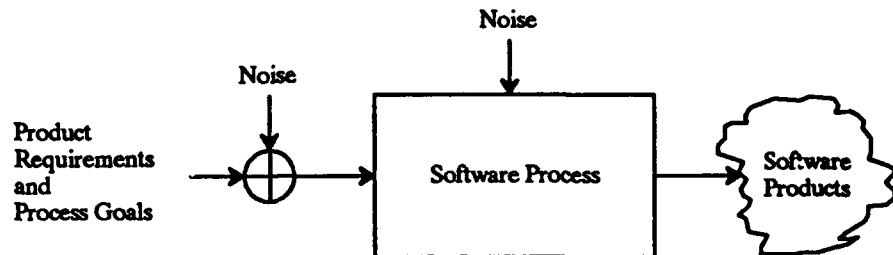


Figure H-1. Software Development at Early Maturity Levels

SOFTWARE MEASUREMENT AT INTERMEDIATE MATURITY LEVELS

A software organization operating at an intermediate maturity level measures some of its software process, though is not likely to derive full benefit from the data it obtains. Therefore, an organization at this level needs to implement a well-planned measurement program that governs the collection and use of the measurements. The program would include development of software standards to define the metrics, and procedures to collect and analyze them. Only then could meaningful benefit be expected from the measurement activity. A process in this state of maturity may be represented by the open loop control system in Figure H-2. The measurement activity has been initiated, but it has not yet developed to the point of applying the measurement data to improve the process. The

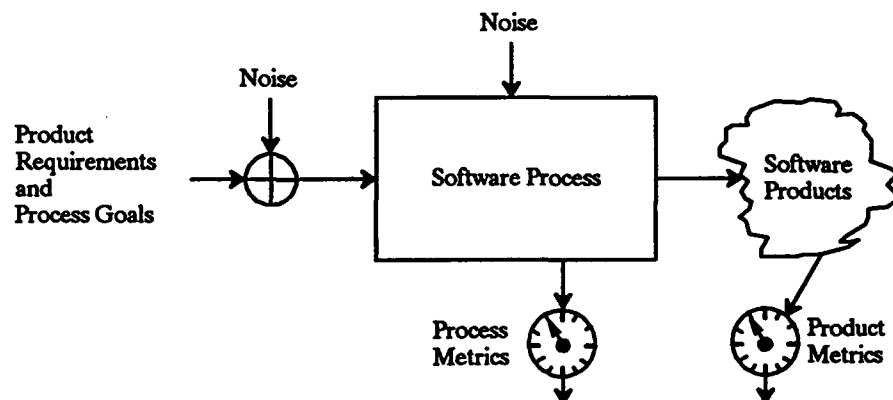


Figure H-2. Software Development at Intermediate Maturity Levels

application of the measurement data to adjust the process would “close the loop.”

SOFTWARE MEASUREMENT AT ADVANCED MATURITY LEVELS

An organization operating at an advanced maturity level has a software development process that can be represented by the closed loop feedback control system model shown in Figure H-3. The model is characterized by inputs for product requirements and size, cost, schedule, and quality goals. The process functions that achieve these process goals are measured at the outputs of the various process activities and the process output. The process output measurements tend to undershoot or overshoot its goals, creating a variance in its attempt to achieve its set point. The amount and type of variance is used to determine the corrective action necessary for the process to meet its goals. Process improvement is achieved when the variances become smaller.

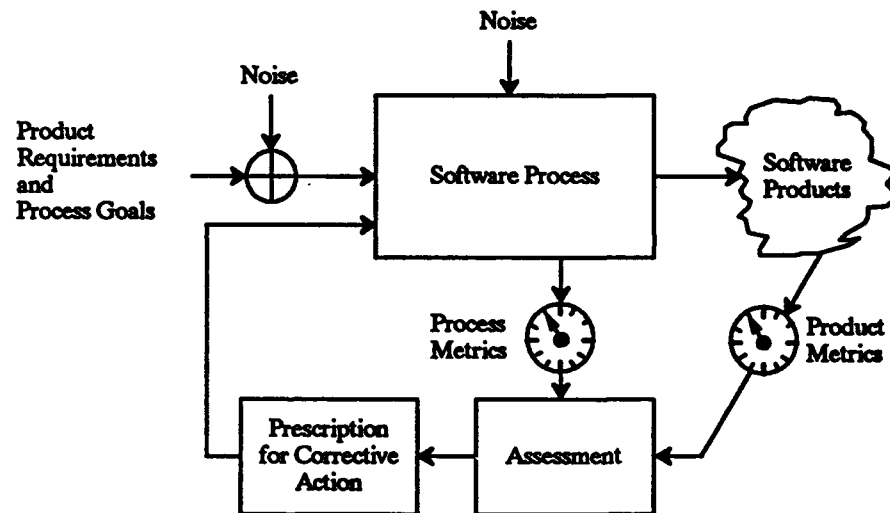


Figure H-3. Quantitative Software Management Process at Advanced Maturity Levels

H.2 GOAL-QUESTION-METRIC PARADIGM

Metrics selection should be based on the goals of your project and organization. You can use the GQM method (Basili and Weiss 1984) to assist you in selecting specific metrics to meet your needs. The GQM method works as follows:

1. State a single goal of current importance to the project.
2. Decide what question(s) you would ask to determine if the goal has been met (or if the goal is being met).
3. Select the metric you need to answer the question(s) of Step 2.

An example of GQM as applied to process improvement follows:

1. My goal is to increase defect removal before practice.
2. Questions may include: "How many defects have been identified?" "How do we go about removing defects?" "How long does it take us to resolve defects?" "When do we find defects?"
3. Metrics that would help answer these questions include number of defects by life-cycle phase, length of time to fix defects, and effort to fix defects.

You can use the GQM method to help you define measurements and metrics to measure your organization's process improvements.

H.3 PROCESS IMPROVEMENT MEASUREMENT

This section provides suggestions for what to measure and when to measure to quantify and verify improvements to your software development process. These measurements are categorized into process, product, and management measurements. Within each category, the metrics are divided according to whether they support an organization at a low, intermediate, or advanced level of maturity. The latter maturity levels build on the measurements established earlier; therefore, measurements for more advanced maturity levels should be gathered by the organization in addition to the measurements listed for earlier maturity levels. Most of the measurements listed support improvements in more than one category.

Each category indicates when you should collect the measurement data. The data is usually collected in the Manage and Monitor activity (see Section 7) in each cycle of the process improvement process. The data you are able to collect is dependent on the status of each of the projects using the improved process; that is, you can collect only the data that is available from projects that are finished using, or in the process of using, some or all of the improved process.

When you collect process improvement measurement data, keep the following points in mind:

- It is important that you maintain a database of your measurements so that you show the extent of the improvements made to the process. Ideally, you can measure the process before any improvements are made and use that as a baseline against which to measure your improvements.
- You will collect the measurement data listed below from a variety of sources within your organization, including accounting reports for cost and effort expended; project management reports for schedule,

staffing, and plan-related information; and configuration management reports and product status reports for product change information.

- The measurements listed in this section do not represent a comprehensive list of all measurements you need to collect. You may take only a subset of these lists and then supplement that list with measurements that are not included here. The final list is up to you and your organization.

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PROCESS MEASUREMENTS

Process measurements provide insight into the effectiveness and efficiency of a process.

- **Low Maturity.** Organizations at a low level of maturity must first focus on establishing effective management activities. For this reason, the following process measurements provide insight into the effort expended on basic management tasks.

The following process measurements should be collected and evaluated at major milestones (including the end) of the projects using the improved process.

- Cost and effort expended on requirements management activities
- Cost and effort expended on project planning activities
- Cost, effort, and other resources expended on performing tracking and oversight activities (e.g., monitoring management metrics)
- Number of changes made to the software development plan, including size, cost, critical computer resources estimates, and schedule changes
- Cost, effort, and other resources expended on performing subcontract management activities
- Cost, effort, and other resources expended on performing software QA activities
- Cost, effort, and other resources expended on performing software configuration management activities
- Number of configuration item change requests processed per unit of time

- ***Intermediate and Advanced Maturity.*** At intermediate and advanced levels, organizations have a well-defined software process covering both management and engineering activities, and they conduct supporting activities, such as training, peer reviews, and intergroup coordination, to ensure the effectiveness of their process and the quality of the product.

In addition to the measures listed in each activity, the following process measurement data can be collected during each cycle of the process improvement process:

- Cost and effort expended on process improvement activities
- Number of management and staff using the improved process
- Percentage of process users using the improved process as intended
- Percentage of process users experiencing the expected benefits from the improvements
- Number of management and staff satisfied with the improved process
- Percentage of improvements that have been incorporated into the organization's governing mechanisms (e.g., policies and procedures)
- Cost, effort, and other resources expended on organizational activities for process assessment, development, and improvement
- Results and recommendations of each process assessment
- Cost and effort expended on process definition activities
- Cost, effort, and other resources expended on providing training opportunities to staff
- Results of training evaluations and reviews
- Number of training attendees
- Number of training waivers granted

The following process measurements should be collected and evaluated at major milestones (including the end) of the projects using the improved process:

- Frequency, causes, and magnitude of replanning efforts
 - For each identified software risk, the realized adverse impact compared to the estimated loss
 - Number and magnitude of unanticipated major adverse impacts to the software project
 - Average length of time for problem reports to be resolved (from initial opening)
 - Cost and effort to analyze, implement, and test proposed changes
 - Cost, effort, and other resources expended by the software engineering group in support of other software-related groups
 - Cost, effort, and other resources expended by other software-related groups in support of the software engineering groups
 - Number of peer reviews performed
 - Cost, effort, and other resources expended on peer reviews
 - Number of work products reviewed
-

PRODUCT MEASUREMENTS

A key element of measuring process improvement is measuring the results of the process: the software products. Relevant product measurements should be collected and evaluated at major milestones (including the end) of the projects using the improved process. The product measurements that are relevant depend on the stage of the project; for example, if the project has just entered the design phase, you can collect data on the number of requirements developed.

- *Low Maturity.* The basic product measures that a low-maturity organization should collect are based on product requirements and source code; requirements is the most visible input to the software process, and code is the most visible output.
 - Number of requirements
 - Number of requirement changes, including changes that are proposed, open, approved, and incorporated into the baseline
 - Number of requirement changes from the customer, end user, and software engineering group
 - Critical computer resources, such as computer memory capacity, computer processor use, and communications channel capacity

- Number of changes to configuration items that are requested, approved, and incorporated into the baseline
- Number of problem reports for configuration items that are generated, approved, and resolved
- **Intermediate and Advanced Maturity.** Intermediate and advanced maturity organizations have insight into inputs and outputs associated with each phase of the software life cycle. This level of maturity allows these organizations to measure the intermediate inputs and outputs. In addition to the measures for the organization at a low level of maturity, the following are suggested product measurements:
 - Size of requirements in number of requirements statements, number of (function) boxes in system diagrams, number of (hardware) boxes in a computer network diagram, and number of major subjects or headings in a system description document
 - Size of design in number of design statements, number of program design statements, and number of structured narrative statements
 - Size of code in number of source statements (i.e., thousand source lines of code, or KSLOC) by language, new, added, modified, and reused; comments; number of object code instructions; number of words in memory; number of screens; number of operators and operands; and number of tokens
 - Number of tests and number of test procedure steps
 - Number of computer software configuration items (CSCIs); number of computer software components (CSCs); number of computer software units (CSUs); number of hardware boxes; number of inputs and outputs; and number of function points
 - Size of documentation in number of pages by document type
 - Percentage of requirements traced to design, code, and test cases
 - Percentage of test coverage achieved
 - Number of defects found during peer reviews in requirements, design, code, and test
 - Number of defects found in testing
 - Number of changes incorporated into the software baseline by category (e.g., interface, security, performance, system configuration, and usability)

.....

MANAGEMENT MEASUREMENTS

Management measurements, sometimes referred to as project measurements, provide insight into the progress of a project. They measure the management attributes of the software development process.

Management measurements should be collected and evaluated at major milestones (including the end) of the projects using the improved process. Management measurements that are relevant depend on the stage of the project; for example, if the project has just entered the design phase, then you can collect data on the estimated-to-actual time and effort spent in requirements activities.

- ***Low Maturity.*** At a low level of maturity, organizations focus on the accuracy of their planning efforts. The following are suggested measurements useful in managing a project:
 - Estimated and actual amount of project effort for each life-cycle phase and for each high-level task
 - Estimated and actual number of personnel for each life-cycle phase and for each high-level task, including change in skill type required
 - Estimated and actual amount of other project costs for each life-cycle phase and for each high-level task
 - Planned-to-actual project schedule (start and stop dates, milestones)
 - Planned-to-actual delivery dates of subcontractor products to prime
 - Planned-to-actual dates of prime contractor deliveries to the subcontractor
 - Planned-to-actual number of software quality assurance product audits and activity reviews held
- ***Intermediate and Advanced Maturity.*** Organizations at intermediate and advanced levels of maturity have much more visibility into the software process at both the organization level and the project level. In addition to the measurements for organizations at a low level of maturity, the following are suggested management measurements:
 - Planned-to-actual process assessment, development, and improvement schedule (start and stop dates, milestones)
 - Planned-to-actual process definition schedule (start and stop dates, milestones)

- **Planned-to-actual project management costs**
- **Planned-to-actual schedule of the software engineering group to support other software-related groups (start and stop dates, milestones)**
- **Planned-to-actual schedule of the other software-related groups to support the software engineering group (start and stop dates, milestones)**

LIST OF ABBREVIATIONS AND ACRONYMS

APB	Assessment Participants Briefing
ATL	Assessment Team Leader
CASE	computer-aided software engineering
CMM	Capability Maturity Model
COTS	commercial off-the-shelf
CSC	computer software component
CSCI	computer software configuration item
CSU	computer software unit
FAR	Functional Area Representative
GQM	Goal-Question-Metric
IPT	Integrated Product Team
ISO	International Organization for Standardization
KSLOC	thousand source lines of code
OSP	on-site period
PAT	Process Action Team
PG	Process Group
PL	Project Leader
QA	quality assurance
QMS	quality management systems
R&D	research and development
ROI	return on investment
SC	Steering Committee

SEI	Software Engineering Institute
SPA	Software Process Assessment
TQM	Total Quality Management
UK	United Kingdom
WBS	Work Breakdown Structure

GLOSSARY

Action plan	A plan that addresses the steps needed to be performed in order to improve an organization's processes. The following components are considered to be essential: (1) action-oriented description of task (for each action item), (2) responsibility, (3) resources, and (4) schedule of checkpoints and milestones. An action plan typically has three parts: a strategic plan, one or more tactical plans, and one or more operational plans.
Activity	A process step typically enacted by a human, requiring process planning and control.
Advocate	A person who promotes process improvement activities within the organization. <i>See also</i> Champion.
Appraisal	An examination of an organization's current software engineering practices from a software process management perspective. An important appraisal goal is to achieve an understanding of the organization's strengths and weaknesses in key process areas. The Software Engineering Institute has developed two types of appraisals—the Software Process Assessment and the Software Capability Evaluation. <i>See also</i> Software Engineering Institute.
Assessment	The activities performed to understand the current state of an organization as compared to some agreed-to metrics.
Audit	<i>See</i> Quality audit.
Authorizing sponsor	An individual in the organization who possesses sufficient authority and influence to initiate resource commitment for major change, such as process improvement. <i>See also</i> Reinforcing sponsor.
Capability Maturity Model (CMM)	A software development maturity model, developed by the Department of Defense's Software Engineering Institute, that provides a framework to assist organizations in improving their software process (Paulk et al. 1991).

Champion	A person who publicly supports the change effort and influences the organization to obtain commitment and resources to implement the change. Champions are usually technical people who have earned the respect of the practitioners and managers. <i>See also</i> Advocate.
Change agent	An individual or group that is responsible for implementing or facilitating changes. An example of a change agent is the Process Group. <i>See</i> Process Group.
Change management	The process of actively and explicitly taking appropriate measures to increase the likelihood of effective and efficient introduction of change in an organization. Also, the body of knowledge pertaining thereto.
Constraint	A limitation on decision(s).
Culture	The values, beliefs, and unwritten rules that shape an organization.
Customer	The person(s) or organization(s) that specify the requirements, accept, and authorize payment for a product.
Cycle	A cycle is a complete traversal of the five steps of the Evolutionary Spiral Process. <i>See</i> Evolutionary Spiral Process.
Decision	A choice among allowable alternatives.
Environment	All external and internal conditions that influence the form, performance, reliability, or survival of an organization (adapted from MIL-STD-721C).
Evolutionary Spiral Process	Any enactment of the evolutionary spiral model, which is an adaptation of the basic spiral model proposed by Barry Boehm (1986; 1988), that emphasizes the evolutionary development of systems.
Frame of reference	The point of view of an individual stakeholder or stakeholder group. The organization's frame of reference is its culture.

Functional areas	Technical stages, phases or unit operations of the software process. For a typical assessment, these are software quality assurance and release, software integration and test, coding and unit test, detailed design, requirements, and high-level design.
Goal	A specific, time-related, measurable target.
Historical data	An accumulated database of metrics, plans, and experience from previous projects.
Influence strategy	A formal or informal, written or unwritten strategy for gaining buy-in from appropriate management and staff on process improvement and its implementation within the organization.
Institutionalization	Represents the activities undertaken by an organization to make a process a routine and necessary part of the organization's work environment.
ISO 9000	A family of standards covering the requirements for quality management systems for manufactured products and services.
Life cycle	A sequence of distinct states of an entity beginning with its <i>initial</i> conception and ending when it is no longer available for use.
Maturity	<i>See</i> Process maturity.
Measurement	A number assigned to a directly observable aspect of a process or product.
Method	Guidance and criteria that prescribe a systematic, repeatable technique for performing an activity.
Methodology	An integrated body of principles, practices, and methods that prescribe the proper performance of a process.
Metric	A function of one or more measurements. A metric may be directly observable or may be derived through a calculation involving one or more metrics and measurements.
Mitigation	<i>See</i> Risk mitigation.
Model	A representation of a thing from which analysis provides approximate answers to designated questions about the thing itself.

Objective	The intended or desired result of a course of action.
Operational plan	A plan that describes the activities performed to transfer a particular technology from a PAT to a project.
Organization	Usually the portion of an enterprise bounded by the span of authority of the senior site executive.
Plan	A designation of tasks and resource allocations for accomplishing a specified objective.
Process	(1) A (partially) ordered set of steps, intended to accomplish specified objective(s); (2) the logical organization of people, machines, tools, methods, and procedures into work activities designed to produce a specified end result (work product). The term software process refers to processes that are intrinsic to developing and evolving software systems. <i>See also</i> Software process.
Process action team (PAT)	A group that is responsible for developing and implementing a plan to improve a specific area of the process.
Process asset	Documentation or work product (e.g., report, policies and procedures) developed during the process improvement process.
Process group (PG)	A group that is responsible for maintaining and improving the process standards, policies, and procedures, as well as refining any process models and historical data.
Process improvement process	The process, as defined in this guidebook, by which an organization improves its processes. It includes the following steps: Understand Context, Analyze Risks and Select Strategy, Plan Improvements, Implement Improvements, and Review and Update.
Process maturity	The extent to which the software-specific processes used by a software organization are explicitly defined, managed, measured, and controlled.
Process user	An individual who performs a process. In process improvement, this individual is expected to change the way work is performed by using the improved process.

Product	The aggregation of all work products resulting from a process or activity.
Program	A directed, funded effort to acquire, develop, or maintain a product(s).
Project	An undertaking requiring concerted effort, which is focused on developing and/or maintaining a specific product. Typically a project has its own funding, cost accounting, and delivery schedule.
Project manager	A person responsible for the management of a project. Also, a person directly responsible for the definition, cost, and schedule of a product.
Quality audit	As used by ISO 9000, a systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.
Readiness to change	An organization's receptiveness to and ability to change.
Reinforcing sponsor	An individual in the organization who possesses sufficient authority and influence to reinforce change efforts, such as process improvement activities. <i>See also</i> Authorizing sponsor.
Resources	People, time, and money.
Risk	A potential for incurring undesirable results.
Risk analysis	The act of identifying, estimating, and evaluating risk to determine whether risk mitigation is necessary.
Risk management	A management approach focused on identifying, addressing, and removing risk items before they become either threats to successful product operation or major sources of rework.
Risk mitigation	Action taken to reduce a risk to an acceptable level by working to change the probability of a risk occurring or the cost of a risk occurring.
Role	A function within the process improvement process.
Software Engineering Institute (SEI)	A federally funded research and development center sponsored by the Department of Defense and managed by Carnegie Mellon University.

Software engineering technology	Technology whose purpose and function is to support the engineering, development, operation, and/or maintenance of a software-based system.
Software process	A process performed to produce, support, maintain, and enhance software. Examples of a software process are a software development process and a software maintenance process.
Software process management	The use of process engineering concepts, techniques, and practices to explicitly monitor, control, and improve the software process. The objective of software process management is to enable an organization to produce software products according to plan, while simultaneously improving its ability to produce better products.
Spiral	One or more cycles that, when combined, accomplish a specific objective.
Sponsor	An individual in the organization who supports process improvement activities within the organization through the allocation of people, time, and money. <i>See also</i> Authorizing sponsor and Reinforcing sponsor.
Stakeholder	A person or group with a personal or business interest in the success or failure of process improvements.
Steering Committee (SC)	The organization that sets priorities for process improvement initiatives and recommends to the sponsor the authorization of all actions undertaken by the Process Group.
Step	Either an activity or an unelaborated action.
Strategic plan	A plan that describes the motivation and direction of the organization's process improvement program.
System	A collection of hardware, software, and people that operate together to accomplish a mission.
Tactical plan	A plan that describes the activities performed during each cycle.
Task	A work assignment (i.e., subject to management accountability) to accomplish a specified objective.

Technology	Techniques, tools, or knowledge that aids in accomplishing some task (adapted from Williams and Gibson 1990; Software Productivity Consortium 1988).
Technology transfer	The process by which a technology goes from development by a technology producer to use by a technology consumer. This term is sometimes referred to as technology transition.
Technology transition	<i>See</i> Technology transfer.
User	The person(s) or organization(s) that will use the system for its intended purpose when it is deployed in its environment.
Validation	The evaluation of work products to determine whether they satisfy customer needs.
Vendor	A supplier of commercial off-the-shelf (COTS) tools or software to be used to develop the product.
Work product	Any configuration-managed artifact that is the embodiment of some data element(s).

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